ELECTRICAL REVIEW

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Manufacturers' Activities

Pointers to Technical Progress

AS in previous war years, electrical manufacturers during 1943 concentrated on meeting the immediate needs of the armed forces. Their activities may be broadly described as, in the main, providing means by which power has been made available in the factories, and this includes the utilisation, where feasible, of substitutes for scarce materials, and the devising of methods of application that have led to economy in labour. The advantages in present circumstances of retaining well established standards rather than following up new lines of development, however full of promise these seemed to be at the outbreak of war, are clear enough, but it should be pointed out that it is the high-water mark of previous practice that is now generally normal.

Turbine Developments

To take an example from generating plant: of the large number of turbo-alternators that has been completed or is on order for home and abroad, a good proportion is designed for individual outputs of from 30,000 to 50,000 kW with steam conditions somewhat better than 600 lb. per sq. in. and 800 deg. F. A pointer to the future in one sphere is to be found in work in hand on the electric propulsion of three ships, in which the turbines are to be supplied with steam at 800 lb. per sq. in. and 850 deg. F., reheated to the initial temperature between the two tandem cylinders.

Although distribution units of up to 500 kVA have provided the bulk of the work in the transformer departments, several examples of larger outputs are prominent, including some of 60 kVA at 132 kV. Another aspect is illustrated by the building of shell-type transformers giving up to 30,000 A for electric furnaces. Air-blast switchgear for higher voltages and air-break switchgear for lower, as well as units of small-oil volume, show signs of greatly extending their fields and are now usefully supplementing the still preponderating ordinary oil-immersed types.

Mining Equipment

Flameproof switchgear has been much in evidence and this, with the demand for motors and control gear to meet the requirements of mining in all capacities up to the several hundreds of horsepower called for in winding, reflects the strenuous attempts being made to increase the amount of coal won.

A measure of the activities in motor manufacture is to be found in the huge growth of kWh supplied to industry during the war years, as shown in the Electricity Commissioners' statistics published in this issue. Included in this total is, of course, the power used by furnaces and welding. The demand for welding equipment of all types continues and arc-welding is replacing oxy-acetylene in many instances, such as in making joints in alloy tubular frames. Atomic hydrogen is proving a valuable aid in tool repair and in depositing working edges on mild-steel bases. Typical of a small application of electricity is the way in which aircraft production has been

speeded up by infra-red drying. Although only a very few of the high spots of electrical war manufacture can be touched on here, these will, we believe, indicate in "token" fashion the magnitude of the part that is being played by electrical manufacturers in bringing victory nearer, especially so as they have been able to send considerable aid to the Dominions and other allies including, urgently, Soviet Russia, in addition to serving the British Forces.

The Honours List

ONCE again, it cannot be said that the New Year Honours List is overweighted with electrical men, but those that are included may be considered as fully deserving of recognition. There are two new knights, Messrs. G. E. Bailey (Met.-Vick.) and A. H. Railing (G.E.C.) and a third if we include Mr. W. T. Halcrow whose hydro-electric work has made his name familiar to our industry. Mr. W. F. Bishop, of Henley's, is made a C.B.E. Sir Thomas Royden, whose interests include the chairmanship of Edmundsons Electricity Corporation, Ltd. and subsidiaries, is created a baron and Sir Allan Powell, chairman of the B.B.C., is made a G.B.E. The O.B.E.'s include Mr. D. Bellamy, general manager of the Hull Electricity Department; an electrical contractor, Mr. T. D. Hunter (Edinburgh); Mr. F. E. Nancarrow, of the G.P.O.; and Mr. O. C. Waygood.

Reorganisation of Supply

IN the course of the leading article on "Electricity Control" in our issue of December 24th we stated that the power companies had asked the I.M.E.A. to study their memorandum on reorganisation in the hope that some measure of agreement might be arrived at. We are told that we have been misinformed, for no such request has been received by the I.M.E.A. In the meantime the I.M.E.A.'s own proposals, in which a different basis will be put forward, are on the way. As these differing views will have to be squared in any scheme of reorganisation it is unfortunate that the task is being left to some outside authority.

Worse Confounded

IT appears that not only is each section of the electricity supply industry to put forward its own plan but each plan is to be publicly criticised by the other parties in a sort of jockeying for position in the eyes of the public. We are not convinced that all this is in the best interests of the industry itself or of the public, but we are quite certain that the people who will have the most say in the matter of reorganisation are but little influenced by special pleading. All the facts and figures are known to them already. What they are concerned with is that as little disorganisation as possible shall occur whatever form is ultimately adopted. The industry will not be shattered to bits in order that somebody or other can remould it nearer to his heart's desire.

Voluntary Rationing

PRE-WAR advances in consumption for lighting, heating and cooking are not, of course, to be expected in present circumstances, in spite of the adoption of electricity for canteens and its labour saving advantages. As figures given in this issue show, the total increase for these purposes during the past four years has been barely that which the rate of increase of a single year would have produced previously. In 1942-43 there was an absolute drop, which is unprecedented and not to be explained by a mild winter but as indicating the effectiveness of the appeals for economy made by the E.D.A., the E.A.W. and supply undertakings. The electricity thus saved has gone towards providing the additional electrical power needed for the factories, which has nearly doubled during the same period and almost equals the consumption in 1938-39 for all purposes.

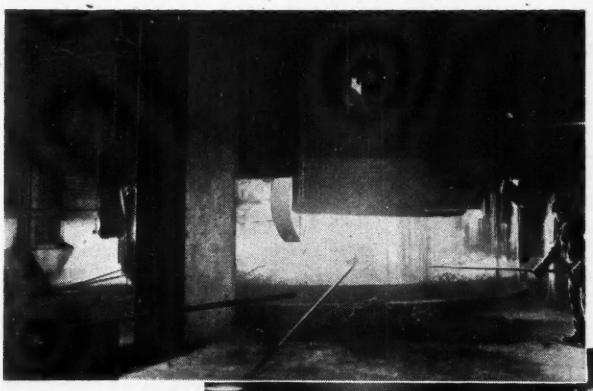
Profits and Rates

ASSESSMENT authorities are very quick to notice increases in the profits of electricity supply undertakings and to act accordingly. When profits go down their reaction is not always so rapid. Eight years ago at the quinquennial valuation the assessment of the Southend undertaking was raised by 75 per cent., mainly because the valuation coincided with a substantial profit before it was possible to distribute it to the consumers in the form of reduced charges. That peak has never been regained; in fact Southend has suffered considerably from the effects of the war, but still the undertaking has to pay for it. The position is worsened by the fact that the local gas undertaking has succeeded in obtaining a reduction in its assessment.

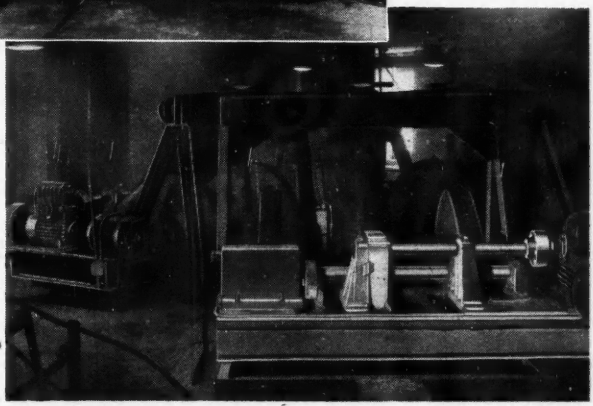
Ferro-Silicon Production

Very Large Smelting Arc Furnaces

DURING a recent visit to a factory producing ferro-silicon we saw very large electric arc furnaces in which the electrode currents are of the colossal order of 52,000 A, and it occurred to us that we were witnessing the beginnings of a new field of electrical development in this country. The handling of such tremendous currents, particularly with regard to the control of heating effects, has demanded, from the operational viewpoint, a start almost from scratch, and outstanding success is being achieved largely as the result of much pioneering work on the part of the electrical staff of the factory. Briefly, the process involves the smelting in the arc furnaces of the raw materials—silica (silicon dioxide S_1O_2) rock, coke and steel turnings—and tapping off the desired product as a 75 per cent. silicon and 25 per cent iron alloy. In the furnace the carbon of the coke combines with the oxygen of the silica to give CO which burns to CO_2 and escapes with fumes drawn from the furnace by means of extraction fans.



From the bottom of the furnace the hearth rises to the first floor, where an open hearth top is presented

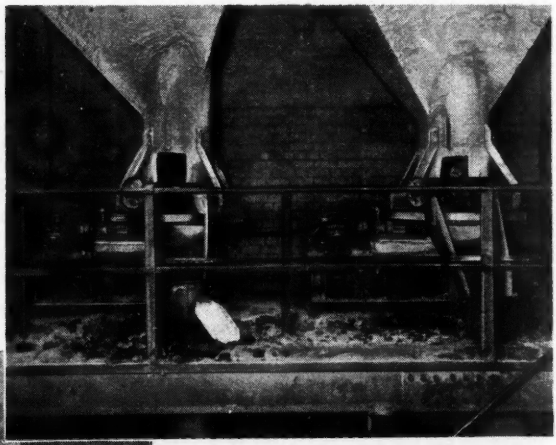


On the top floor are winches by means of which the feeding rate of the electrodes into the hearth is controlled

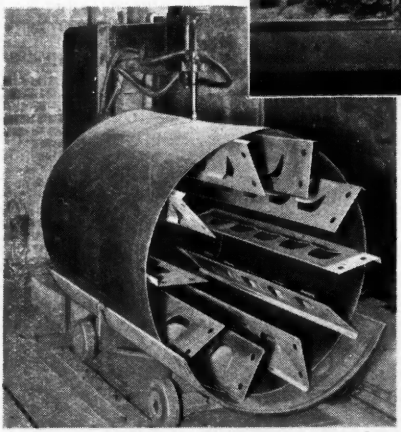
Each of a number of furnaces engaged or to be engaged on this work is loaded to about 10,000 kVA, and in the newer equipments there are some alterations in the constructional features, relating mainly to the very heavy current-carrying arrangements, consequent on experience obtained in operating the earlier furnace. The furnaces are erected within a building structure containing four service floors, the total height being about 70 ft. At the ground floor where tapping takes place from the bottom of the furnace the furnace body rises to the first floor where an open top is presented, the total internal furnace depth being about 10 ft. The electrodes are "buried" in the charge in the hearth to a depth of 4 to 8 ft. The internal diameter of the hearth is about 20 ft. and briefly the hearth construction is as follows. At the bottom there are about four courses of refractory firebricks from which rises an 18-in. cylindrical firebrick wall to the full height of the furnace. On the bottom firebrick is a bed of carbon blocks about 3 ft. deep, from the top of which the carbon is extended upward at the perimeter and in this way forms a short inner

wall about 1 ft. in height.

The molten metal drains down from the charge and collects in the carbon "bath" so formed until tapping is effected. Surrounding the firebrick wall is a one-inch thick steel cylinder, and a space of about three inches between this and the firebrick wall is packed with sand, thus providing for some expansion and sealing to prevent burning away of the carbon blocks. The complete furnace rests on



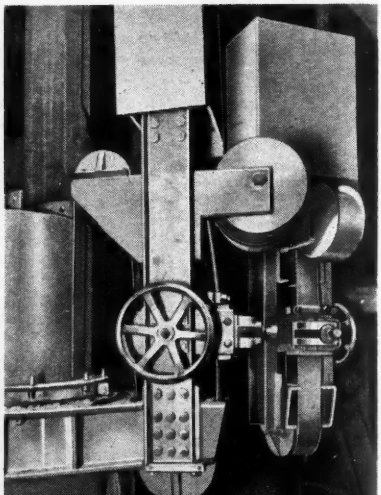
On the second floor are rotary feeder tables which deliver the charge to the furnace



After being built up on a jig the electrode casing assembly is finally welded up on a spot welder

concrete beams which also constitute a system of air ducts for cooling. On the first floor, above head level and directly over the top of the furnace, is a large cylindrical outer casing in which the fumes from the open top are collected for removal by an extraction fan. On the second floor are rotary feed tables which deliver the charge to the furnace, and here also the continuous-feeding Soderberg electrodes are extended in accordance with their rate of consumption in the furnace below. On the top floor are winches by means of which the feeding rate of the electrodes into the furnace is controlled, as well as raw-materials storage bins which serve the feeding tables on the second floor.

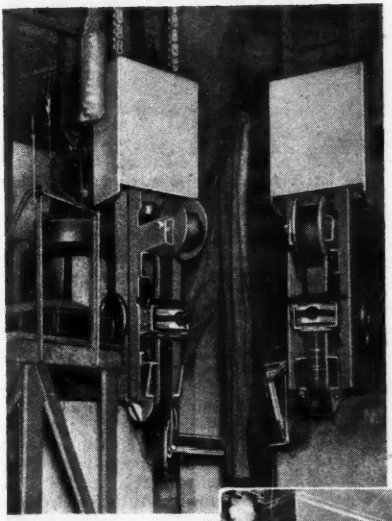
The charge materials are mixed in their required proportions on the ground floor and are then fed by means of an overhead crane into hoppers which chute-feed skips suspended on a monorail system. The filled skips are pushed along into a lift or hoist which elevates them to the top floor where they are transferred to another monorail system which serves a series of bunkers and, in turn, the



Movement of the electrode proper is provided for independently of that of the mantle; support is by means of a steel band welded to the electrode casing

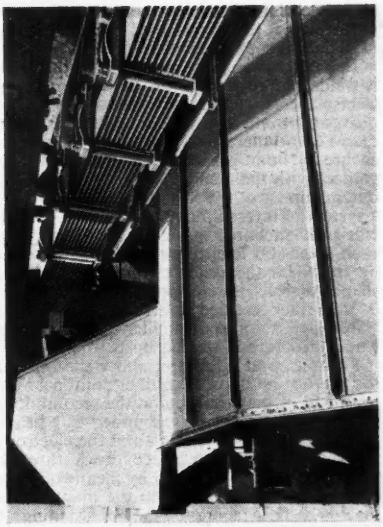
feeder tables. The material falls on to the horizontal revolving disc of each feeder table and the table movement pushes the material through a gate at one point on the periphery, to fall into a chute which feeds it directly on to the furnace top. There are seven feeder tables per furnace.

It is essential for a proper understanding of the operation of the electrodes with which we are here concerned to appreciate the following points : Firstly, that because of the continuous-operation principle of the furnace—there are no breaks for charging or tapping—



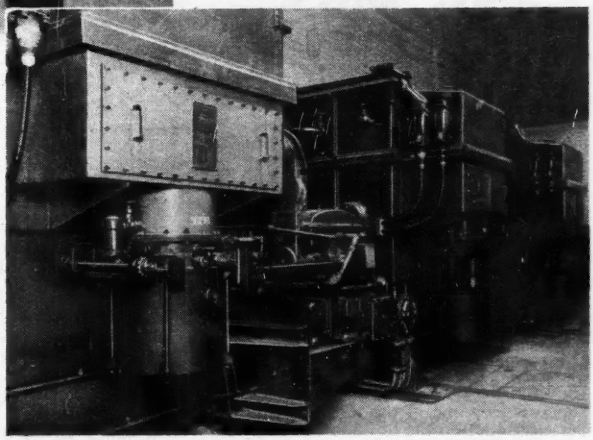
Each mantle and its electrode are chain supported by one of the winches on the top floor; note main tamping at top of electrode

the electrode must be continuously manufactured (extended) at the top end while it is being continuously consumed at the bottom end. Secondly, that as each of the three electrodes per furnace weighs about 16 tons, extraordinary arrangements are necessary for supporting and controlling the movement of the electrodes. Each electrode is 41·25 in. in diameter and it extends from the arc



There are a dozen bars in each bus-bar run to an electrode—six bars on each transformer leg

near the bottom of the hearth up to the second floor. Here the electrode-production material is softened in a gas oven at 125 deg. C from a solid form into a paste form in which it is conveniently fed to the top of the electrode. This is made possible by means of a steel casing which is extended in 4-ft. lengths and which becomes part and parcel of the

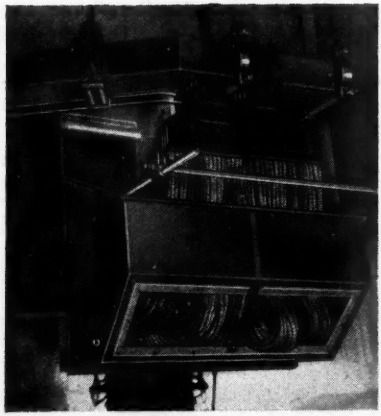


The three electrodes for each furnace are supplied on direct delta connection from a 10,000-kVA bank of three 11-kV transformers ; diverter switches (one open) under sliding-contact equipment

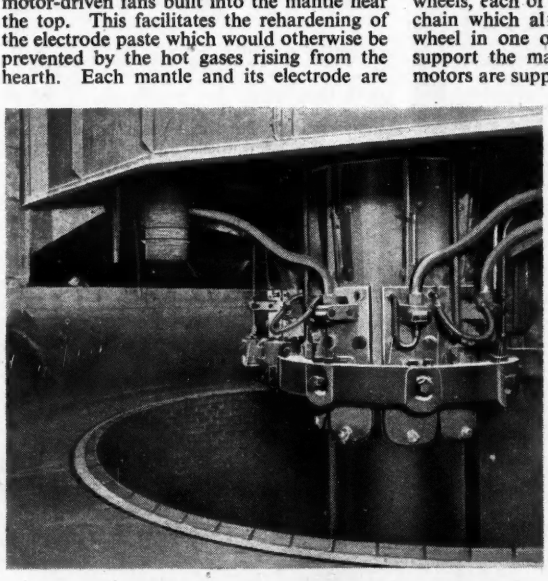
electrode right down to the consuming end where it is just consumed with the raw materials of the charge.

Each extension piece of the electrode casing is welded on to the top projecting end of the electrode casing, and there is always a hollow piece at the end into which the paste is introduced and tamped down by a wooden tool to ensure a homogeneous whole and intimate contact with the members of the casing. The outer cylinder of the casing is built up around a system of internal fins by which the paste is efficiently anchored to the casing. The fins of each extension length are first built up on a jig to which the outer cylinder, after being shaped on rolls, is then applied. The assembly is then tack welded together before being transferred to a spot welder on which the whole structure is welded up permanently.

From a point a few feet above the furnace top on the first floor to another point near the open end of the electrode on the second floor the electrode proper is surrounded by a heavy steel mantle between which and the electrode proper is an annular space down through which cooling air is passed by means of three motor-driven fans built into the mantle near the top. This facilitates the rehardening of the electrode paste which would otherwise be prevented by the hot gases rising from the hearth. Each mantle and its electrode are supported by one of the three winches (one per electrode) on the top floor. Each winch motor is a 10-HP, 950-RPM DC unit which transmits *via* a 950/16-RPM reducing gear and a shaft and countershaft to two sprocket wheels, each of which engages a " free-end " chain which also engages a larger sprocket wheel in one of the heavy carriages which support the mantle. The three DC winch motors are supplied from a 60-kW rectifier in the furnace substation and they are normally controlled automatically from a central control panel situated close to the furnace.



The latest practice is 128 bare-copper flexible cables per phase, each cable consisting of 19/7/7/0·029 conductors



Each bus-tube terminates at a heavy clamping piece suspended from the mantle; the clamping pieces are held tightly to the electrode casing by means of heavy bolts bearing from a clamping ring

Movement of the electrode proper is also provided for independently of that of the mantle; indeed, by the same means the electrode is supported in correct relationship to the mantle. This support is effected by means of a steel band about seven inches wide which is run out from a coil on each mantle supporting carriage and tack welded progressively to the electrode casing. In its double-U path from the coil to the electrode casing the band passes through a hand - wheel controlled toggle clamp by which it is " held " or allowed to "slip" as required, so that the electrode proper moves without the mantle. A " slip " of about six inches each time is allowed, and a check on this is provided by means of a simple bar clamp on the band at a point six inches above an " anvil " on the toggle-clamp member, so as to provide a stop when the bar clamp and anvil meet. There are, of course,

three electrodes per furnace, and so as to permit variations in the pitch circle of these there are in the actual top floor slots through which the winch chains pass and by which considerable latitude of the position of the chains is afforded, and corresponding openings in the tamping floor around the mantles. The latter are shrouded to prevent the passage of gases from the furnace on the floor below.

The three electrodes for each furnace are supplied from three 11-kV or 6·6-kV single-phase transformers which are delta connected on the high- and low-voltage sides. The arc operating voltage (secondary) is very variable, according to the depth of the electrodes in the charge, for example, but a good average value is 147 V. Voltage variation is provided for, however, by a comprehensive system of on-load tap changing with special load-diversion arrangements in view of the heavy currents involved. The tapping is effected on the primary and about a dozen taps are brought out to a double-bar sliding-contact arrangement, with each bar connected to one and the opposite sides of a two-way diverter oil circuit-breaker. The sequence of operation of the diverter switch is:—one side only closed, both sides closed, the opposite side only closed, so that by the judicious and progressive operation of both the diverter switch and the sliding contacts no circuit-breaking takes place on the sliding contacts. One result of this arrangement is that, in effect, the number of useful tappings on the circuit as a whole is about double the number of actual tappings on the transformer winding. Both the sliding contacts and the diverter switch are operated by the same motor which is normally push-button controlled from the central furnace control panel on the first floor.

Heavy Bus-Bar System

An outstanding feature of the whole installation is the special distribution arrangements for handling the very heavy furnace currents. There are three bus-bar runs from each transformer group to each furnace, *i.e.* one run per electrode. There are a dozen copper bars in each run, each bar measuring 13 in. wide and ¾ in. thick. Six of the bars are from one transformer leg and six from an adjacent leg, so as to afford the direct delta connection on the electrodes. The twelve individual bars are disposed alternately side by side with respect to the transformer legs which they represent, so as to eliminate induction effects. The whole group of twelve bars is suspended with the bars in the vertical plane from the roof by means of insulated clamp-type cradles at about 3-ft. centres. Each cradle has two suspension rods with an adjustment link in each. Initially all the suspension bolts at the bottoms of the cradles were of steel, but in one case in each run the bolt just melted away under excessive heat. This particular bolt is disposed between the two downward leg connections from the bus-bars to the electrode, and it is assumed that the overheating was due to its position in the intense magnetic field created by the currents in the connectors, and the cessation of trouble with the replacement of the steel bolt by a non-magnetic one certainly seems to confirm this.

Before the furnace is tapped the plugging in the tapping hole is burnt through by a 3-in. graphite electrode

Because of the movement of the electrode, one section of the connection from the bus-bars is flexible and connects with special heavy lug terminals at each end, one set being directly bolted to the bus-bars. These terminals are also the subject of a modification since the first furnace was installed because of trouble consequent on unequal loading of the flexibles owing to induction effects. Mallory metal castings are now used and the following respective conductivity and Brinell hardness figures for castings afford a most interesting comparison in this respect: Copper, 80 per cent. and 40; brass, 25 per cent. and 45; gunmetal, 10 per cent. and 65; and Mallory, 80 per cent. and 110. The number and size of the flexibles per connection have also been altered and the latest practice is 64 bare copper flexible cables per phase, each flexible cable consisting of 19/7/7/0·029 conductors. Each flexible cable is inserted into its hole in the lug and a copper wedge is then driven into the centre of the flexible at the exposed end, thus expanding the strands outward. The whole

is then welded solid. The terminals actually on the bus-bars are water cooled by direct sprays, and they are cleaned down weekly.

From the terminal blocks at the other end of each flexible link the current is conveyed direct to the electrode by means of bus-tubes, each about two inches in diameter. There are eight tubes per electrode, *i.e.* four on each transformer leg. Each tube terminates in a heavy water-cooled clamp which is suspended from the bottom of the electrode mantle, and the whole eight clamps are held tightly to the electrode casing by means of heavy bolts which bear on them from a pressure ring surrounding the whole of the clamps which afford the actual electrical connection to the electrode. The terminal blocks, bus-tubes, clamps and pressure ring are all water cooled, water flowing through them in the order named by special connections.

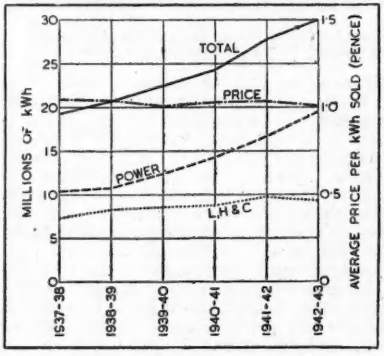
Before the furnace is tapped the plugging in the tapping hole is burnt through by a "tapping electrode," a 3-in. graphite single-phase electrode which is supplied from a tapping on one of the transformer legs, *via* a s.p. circuit-breaker, and feeds back into the main arc. The ferro-silicon is poured into a suitably lined ladle in which it solidifies before being tipped out and broken up by a ball drop ready for supply to the steel makers.

Electricity Output

Commissioners' Figures for 1942-43

FROM particulars furnished us by the Electricity Commissioners the accompanying curves have been drawn to show the growth in the kWh sold during the war years by authorised electricity undertakings in Great Britain, and also the way in which the proportions of the sales in the two largest groups of consumers have varied over the same period.

Compared with the last complete pre-war year (1938-39) the total is nearly half as much again, being 30,061 million kWh as against 20,793 million, with corresponding revenues of £126·5 million and £90·1 million.



Sales of electricity during the war period

The main cause of this increase is a growth in consumption for industrial power of from 10,841 million kWh in 1938-39 to 19,517 million kWh in 1942-43. During the same period sales for lighting, heating and cooking rose from 8,340 to 9,353 million kWh. In this way power accounted for approximately 65 per cent. of the whole instead of the 52 per cent. for the earlier year, the proportion used for lighting, heating and cooking declining from 40 to 31 per cent.

The loss of most of the public lighting load, which dropped from 376 million kWh to 21 million kWh, has not materially affected results because it formed at best less than 2 per cent. of the combined total and is now only 0·1 per cent. There has been some decrease in traction supplies, *i.e.*, from 1,235 million to 1,170 million, but this has meant only that their percentage of the whole has fallen from 6 to slightly under 4.

The overall average price per kWh sold (1·01d.) is actually lower than it was before the war (1·04d.), but this result is due to the greater consumption of lower-priced electricity for power, since there has been an increase in each category. Comparative prices per kWh were for 1938-39 and for 1942-43:—Lighting, heating and cooking, 1·606d. and 1·647d.; power, 0·657d. and 0·718d.; public lighting, 1·044d. and 3·927d.; traction, 0·586d. and 0·738d.

The last occasion on which similar particulars were released by the Electricity Commissioners was in the autumn of 1942 (*Electrical Review*, October 2nd, 1942). These related to the year 1939-40. In order to complete the record the following figures (million kWh and pence per kWh) are given for the intervening years. For 1940-41:—Lighting, heating and cooking, 8,810, 1·644d.; power, 14,342, 0·68d.; public lighting, 16, 5·788d.; traction, 1·139, 0·67d.; total, 24,307, 1·033d.; total revenue, £104·6 million. For 1941-42:—Lighting, heating and cooking, 9,875, 1·605d.; power, 16,754, 0·718d.; public lighting, 20, 4·542d.; traction, 1·166, 0·706d.; total, 27,815, 1·035d.; total revenue, £120 million. The "years" end for public authorities on March 31st in England and Wales and on May 15th in Scotland and for companies on December 31st.

Temperature Limits

Factors Determining Values for Oil-Immersed Transformers

By C. H. Pike,
Graduate I.E.E.

APART from failure due to abnormal electrical or mechanical stresses, the life of a transformer depends on how long the requisite mechanical strength of the insulation can be maintained under service conditions. The critical constituent of most transformer insulations is cellulose. This deteriorates at a rate determined by temperature, air and moisture content, electric stress, and degree of purity of the oil in which the insulation is immersed. The most deleterious factor is temperature.

When cellulose insulation is practically free from moisture the rate of mechanical deterioration is very low up to 75 deg. C., but such a limit would restrict the output and the materials would not be used economically.

Life-expectancy would, however, be in the region of forty years (1) for insulation in oil at a continuous temperature of 75 deg. C. Lower temperatures for some part of the time would lengthen the period. On the other hand insulation maintained at 110 deg. C.

TABLE 1.—TEMPERATURE LIMITS (DEG. C.) FOR OIL-IMMERSED TRANSFORMERS WITH CLASS A INSULATION

Type	Limits based on B.S.S. 171		Alternative Limits
	A Average Copper	B Hot Spot	C Hot Spot
OW	85	90–95	95
ON	95	100–105	95
OB	95	100	95
OFW	95	97·5	105
OFN	100	102·5	100
OFB	100	102·5	100

For air-cooled types peak temperatures 5 deg. C. higher are permissible provided that the average temperatures over twenty-four hour periods do not exceed the values shown.

would have a life of about five years, so that an economic transformer life requires temperature limits within which the unit can be operated continuously during a predetermined period.

B.S.S. 171/1936 tabulates temperature-rise limits for transformers with different types of cooling but gives no indication of life-expectancy. As, however, the economic life of a transformer is frequently considered as being from twenty to twenty-five years, the conditions of the B.S.S. are assumed to refer to a life-expectancy of twenty years, *i.e.* for that period a transformer can be operated continuously at the appropriate temperature-rise. Since the temperature-rises specified are above stated reference ambient temperatures, equivalent average copper temperatures—as distinct from temperature-rises—can be obtained by adding the temperature-rise to the ambient temperature. On this basis limits of average copper temperature are as shown in Table 1, Column A. As, however, the useful life of the insulation depends on that of the hottest parts, the operating temperature of these is the critical value concerned.

Because of variations in design no definite maximum or hot-spot temperature limit can be assigned to each type of transformer, but the values shown in Column B should be reasonably representative of the hot-spot temperatures corresponding to the copper temperatures shown in Column A. Also, all transformers cannot be operated at the same hot-spot temperature since the permissible value depends on the extent and location of the hot spots. Thus the hot-spot limit will be determined by such factors as temperature - gradient across the insulation, number of cooling ducts and type of cooling. Again, with a low gradient between hot spot and hottest oil, the hot-spot limit may be determined in relation to the maximum temperature considered suitable for the oil.

Deterioration of Insulation

Published results of researches on the mechanical deterioration of insulation do not conclusively support any particular values of hot - spot temperatures for continuous operation for a definite life period. Some years ago V. M. Montsinger (1) found, in general, that the rate of mechanical deterioration of oil-immersed insulation doubles for each 8 deg. C. increase of temperature. He states the approximate time at various temperatures in which the life of oil-immersed insulation would be reduced to zero as follows:—

Temp., deg. C.:	30	40	50	60	70	80	90	95	100	105	110	120
Life, years:—	94	82	70	58	46	35	23	16	10·5	7·0	4·5	1·9

Recently F. M. Clark (2) showed that at 75 deg. C. the tensile strength of manilla paper under oil deteriorated to 50 per cent. of the original value in 4,000 weeks with specimens in sealed tubes containing oxygen above the oil surface and 6,400 weeks with nitrogen. Table 2 shows 50 per cent. life values at higher temperatures. Within the 75 to 100 deg. range the effect of temperature change was extremely marked whether in the absence or presence of oxygen. In general the rate of deterioration doubled in the 75 to 90 deg. range for each increase of about 2 or 3 deg.; in the 90 to 105 deg. range

for 3 to 6 deg.; and in the 105 to 200 deg. range for 8 deg.

From the above data with temperature limits for continuous operation in the region of 100 deg. C., life-expectancy would be considerably less than twenty years. However, these values obtained by comparatively short-time laboratory tests, and, in most cases, by extrapolation, do not necessarily indicate the rates of insulation deterioration under service conditions. In the tests specimens were heated in sealed tubes with all components at the same temperature, so that all the deterioration products were retained either in the material or in the oil.

TABLE 2.—PERIOD FOR DETERIORATION OF TENSILE STRENGTH OF INSULATION TO 50 PER CENT. OF ORIGINAL VALUE AT VARIOUS TEMPERATURES

Temperature deg. C.	Gas at Oil Surface	
	Oxygen	Nitrogen
	Weeks	Weeks
100	50	70
110	14	20
120	3·5	6

Now, the rate of cellulose deterioration depends on the extent to which the products are retained in the body of the material. These include water (which is considered to activate some of the other products) of an amount that can be absorbed by the oil. In a transformer water is continuously transferred to the oil if this can be kept sufficiently free of moisture to avoid saturation, whereas in the tests the amount of water removed from the insulation is limited.

Oil circulation in a transformer should also assist the transfer of water and because of the unequal temperature distribution in the oil there are cool zones in which the effect of deterioration products is reduced as a result of condensation, whereas in the tests the products remain active and cause acidity of the oil which also affects the mechanical strength of the insulation. Other tests indicated that specimens aged in open vessels exposed to air, as in service, deteriorated at a lower rate than the specimens in sealed tubes with nitrogen atmosphere.

The mechanical life of cellulose insulation is shown by Clark to be halved for each 100 per cent. increase in water content up to 0·5 per cent. of its dry weight. Furthermore, the effect of oxidation on mechanical life becomes more pronounced in the presence of moisture, oxygen in the cellulose causing serious deterioration at 100 deg. C or less. In the region of 100 to 120 deg. C., pyrochemical decomposition becomes the most pronounced cause of deterioration.

Most of the tests were concerned with reduction in tensile strength, whereas transformer insulation is subject more to compression and shear stresses than tensile. Apart from heat and moisture other factors contributing to deterioration may be electric stress high enough to ionise air and other gases and heating of the insulation owing to dielectric losses as well as to copper losses, but generally the latter is not usually of practical importance.

Oil Temperature

In some types of transformer, at the maximum permissible insulation temperature, the oil temperature will still be relatively low—about 60 to 70 deg. C., but with others the oil temperature may also reach the maximum permissible. The objection to high oil temperatures is a possibly excessive rate of acid formation when oxygen is available at the hot-oil surface. The remedy is to exclude air or minimise the temperature and the surface area of the oil actually in contact with atmosphere by means of a conservator. Where conditions favour acidity development, high temperatures may necessitate frequent replacement of oil.

After taking into account temperature-gradients between windings and oil and, in consequence, the temperature distribution in the insulation and the possible presence of small quantities of moisture, air and acid in the oil and insulation, probably the temperature limits shown in Columns A and B, Table 1, are too high for air-cooled types and too low for water-cooled types. Alternative values of maximum or hot-spot insulation temperatures (average) are shown in Column C. Lower values for air-cooled types are advisable because of the uncertainty of insulation life at high temperatures and also, with artificially cooled units, because of the possibility of failure of auxiliary motors when a transformer is operating at peak temperature. Artificially cooled units are generally located where such a contingency can be met almost immediately; nevertheless, the sharp increase of temperature for a short period makes a margin of a few degrees advisable.

Time Factor

As deterioration of mechanical strength of insulation is a function of both temperature and time, the life of a transformer will not be unduly shortened by a very high temperature of short duration, although the effect of excessive temperature on a number of occasions is additive and would, therefore, substantially reduce the life of the insulation. On the other hand a reduction in the temperature for continuous operation of a few degrees will have a considerable effect. Using a 5 deg. C. rule, V. M. Montsinger (2) estimated the probable life of a transformer operated at a temperature-rise of 60 deg. C. at only one-half that with 55 deg. C. rise. The extra capacity gained by the increased temperature-rise would amount to about 6 to 7 per cent., which would decrease the

cost per kVA of output by about 3 to 4 per cent.—a gain that would be uneconomic in view of the halved life.

For water-cooled units the values shown in Columns A and B, Table 1, may be too low. They are based on temperature-rise limits which allow for the failure or reduced efficiency of the cooling system in service. Where supervision or safeguards are provided, water-cooled units can be loaded up to the limit of thermal capacity.

In practice, transformers are seldom, if ever, operated continuously at maximum permissible temperatures or even at full rated loads throughout their life, so that predictions of life-expectancy under these conditions are largely academic. It is, however, of practical interest to know whether transformers can be operated safely at high temperatures for periods. The published evidence does, at least, suggest that they can be loaded up to the limit of thermal capacity for several hours a day without reducing the life-expectancy to below twenty-five or thirty years. The temperature values in Column C are considered to be suitable standards for thermal loading irrespective of ampere loading. Actually, each transformer will have an economic temperature limit determined by design and conditions of use, but, in order to ensure long life, moisture and air must be excluded from the ambient oil, which must be periodically purified.

Transformers can only be loaded up to their temperature limits if a hot-spot or winding-temperature indicator or a safe-load indicator are fitted. There are several advantages of being able to exploit a margin of thermal capacity,* but although this can be partly utilised by establishing limits of hottest-oil temperature on the basis of known conditions, these values must necessarily be conservative, and a representative indication of insulation temperature is to be preferred.

Bibliography

(1) V. M. Montsinger, "Loading Transformers by Temperature," Trans. A.I.E.E. 1930, Vol. 49.

(2) F. M. Clark, "Factors Affecting the Mechanical Deterioration of Cellulose Insulation," and V. M. Montsinger, H. Halperin and J. G. Ford, discussion on paper. Trans. A.I.E.E. 1942, Vol. 61.

(3) C. F. Hill, "Temperature Limits Set by Oil and Cellulose Insulation," Trans. A.I.E.E. 1939, Vol. 58.

(4) F. J. Vogel and T. K. Sloat, "Emergency Overloads for Oil-Insulated Transformers," Trans. A.I.E.E. 1942, Vol. 61.

(5) F. J. Vogel, P. Narbutovskih, "'Hot-Spot' Winding Temperatures in Self-Cooled Oil-Insulated Transformers," Trans. A.I.E.E. 1942, Vol. 61.

* See "Loading of Transformers," by E. T. Norris, *Electrical Review*, February 5th, 1943, and "Transformer Loading," by C. H. Pike, *Electrical Review*, May 7th, 1943.

English Electric Apprentices

AN innovation was made at the Stafford works of the English Electric Co. when apprentices, their parents, and the management of the company met to discuss apprentice training. The opportunity was also taken to present indentures to apprentices who had completed their training during the year and to announce merit awards. Officials of the company present included Mr. A. D. Sloan, chief engineer, and Mr. J. W. C. Milligan, assistant to the general manager, and Mrs. Milligan, while among the visitors were the Mayor of Stafford (Councillor A. E. Hourd), the Mayoress, and Capt. R. W. Steventon, secretary of the County Youth Committee.

Mr. Caunce, superintendent of the company's Technical Education Department, said it was hoped that once a year those interested would be able to meet to review the work done. He outlined the scheme of apprenticeship and said that the company has had in operation for over a year a school within the works which trade and engineering apprentices attend full-time for their first year. This school includes a well-equipped workshop with up-to-date machine tools and its function is to give a sound basic training in bench work and machine work on which the apprentice can place his further experience in subsequent years in the main shops. A large school centre is planned in which all forms of training will be carried out. The scheme of training will be supplementary to the instruction given at the Stafford Technical College, where it is hoped that very soon most of the instruction will be carried out in the daytime instead of in the evenings, a practice which is apt to overstrain a growing boy. Mr. Caunce emphasised that the policy of the company was to fill all its posts from its own apprentices.

The merit awards, which were then distributed, took the form of vouchers for buying books, instruments or tools useful for the apprentices' training. An award once made continues to the end of the apprenticeship and there is thus a cumulative effect as a new award is added to the "carry-over" award from the previous year. It is possible for a trade apprentice if his progress has been first class in his five years' apprenticeship to gain a total of £56 5s. After presenting the awards Mr. Milligan read a message from Sir George H. Nelson, chairman and managing director, who stressed the immense opportunities existing for those who showed ability, enthusiasm, and initiative.

Chemical Engineering Lecture

A lecture on a chemical engineering subject has been endowed by Mr. J. Arthur Reavell and will be given under the auspices of the Institution of Chemical Engineers. It will be known as "The J. Arthur Reavell Lecture" and will be delivered not less frequently than once in every four years.

Frequency Comparison

The Use of a Cathode Ray Oscilloscope

By G. F. Freeman,
M.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E.
(West Ham Municipal College)

THERE are various ways in which two frequencies may be compared with the aid of a cathode-ray oscilloscope, either a voltage or a current at each frequency being required to deflect the ray or vary its velocity or focus. Of the several methods available, the easiest to apply are those in which no change is involved in the internal

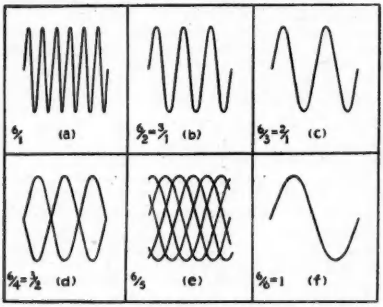


Fig. 1

connections of the oscilloscope as ordinarily supplied. Two such methods are here considered.

Where one of the frequencies is a simple multiple of the other, there is little difficulty in counting cycles, providing the difference is not too great—say up to a ratio of 30 or so. For example in Fig. 1, in which a linear time base synchronised to the lower of the two frequencies is premised, in cases (a), (b), (c) and (f) the frequency ratios are obviously 6, 3, 2 and 1 respectively. In (d) and more particularly (e) the interpretation of the figure is less obvious, but it is not difficult to deduce that the wave is repeated three times in two base cycles in (d) and six times in five base cycles in (e), giving ratios of 3:2 and 6:5.

The number of distinct stationary figures that may be observed on the screen depends primarily on the duration of the afterglow, the writing speed and the persistence of vision. Apart from these, any defect in focusing, impurity of wave form or lack of steadiness in the controls will adversely affect recognition of the more complicated figures. Travelling figures are of course readily interpreted in terms of the observed positive or negative creep of a recognisable form, but the difference between, say, 13:14 and 15:16 is so slight that most users will prefer to "fix" the picture for observation, which is generally possible if both frequencies are sufficiently steady and one of them can be gradually varied over a limited range.

In Fig. 2 the figures for frequency ratios reciprocal to those of Fig. 1 are given (*i.e.* the higher frequency is synchronised to the time base). Here again there is no great difficulty in picking out the forms, but previous acquaintance is a distinct help in recognition. All the traces of Figs. 1 and 2 and a number of others of similar form may be observed by feeding the oscilloscope with a voltage at 50 cycles per sec. on the Y plates and turning the velocity knob of the (unsynchronised) time base *slowly*.

As an alternative to the linear time base method, the X plate may be energised at one of the two frequencies and the Y plates at the other, either directly or through an amplifier or voltage reducer ; the result is a Lissajous figure. In Fig. 3, form (a) becomes an open ellipse, passes through form (b) and closes again to form (c) as the phase difference between two equal voltages of the same frequency is varied from zero to 180 deg. (The oscilloscope in this connection makes a sensitive synchroscope.) Forms (d), (e) and (f) depict corresponding variation for a 2 : 1 frequency ratio, with the higher frequency applied to the Y plates.

Figures in which both variants reach their maxima at the same instant are somewhat

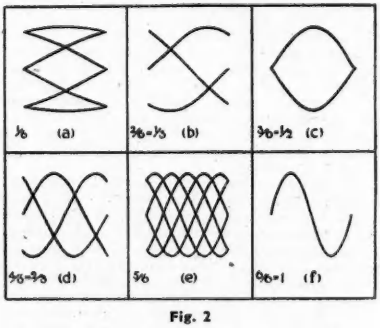


Fig. 2

easier to pick out than other phasings—the adjustment of phase is normally made without difficulty—and the traces in Fig. 4 are all of this variety. Together with Fig. 3 they give the traces corresponding to all proper fractional ratios between 1:8 and

7:8 which have denominators of 8 or less. Any trace may be identified by counting the number of times the figure is crossed from left to right and from top to bottom, starting and finishing at a dead end. For example, in case 4 (p) the state point in moving from the top left corner to the top right corner makes 5 horizontal and 8 vertical traverses ; the ratio is therefore 5 : 8 or 8 : 5, depending on which frequency is taken as the datum. (Note also that the intersections and maxima are in line both horizontally and vertically, which is a useful check when sketching the figures.) For convenience the same amplitude has been taken for X and Y; this is of course not essential, but approximately equal amplitudes assist in recognition.

The traces are sometimes complicated by harmonics and stray potentials, especially if a mains driven oscilloscope is used and the

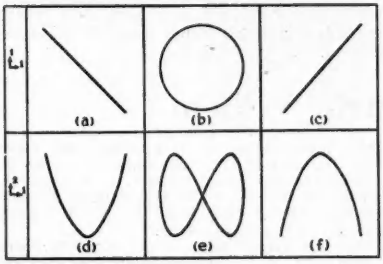


Fig. 3

pick up voltages are so small that high amplification is required. Proper earthing and screening can do much to reduce strays, and a filter circuit will materially improve the wave form. A curious and, so far as I am aware, unavoidable cause of multiple traces is the sub-harmonic on multipolar alternators which results from the fact that cyclic repetition occurs strictly only once per revolution and not once per pole pair ; on some small machines this blurring effect is quite appreciable.

Practical Details

Lissajous figures have long been used with an optical device in the accurate comparison and adjustment of tuning forks, relying on persistence of vision to present a complete picture. The oscilloscope extends their field of usefulness considerably, requiring only that the vibrations shall be reproduced electrically for observation. The remarks which follow apply principally to figures of this type.

Oscillator frequencies of the order of 1000 cycles per sec. are readily measured in this way in terms of frequency-stabilised mains, a trace similar to Fig. 4 (a) being obtained. If the oscillator frequency is fixed, it is a convenience to have as a working standard an alternator running at about 50 cycles per sec. with a smooth speed adjustment over a limited range and connected, say, to the X plates. The Y plates being connected to the oscillator, the speed is adjusted to obtain a stationary figure and the Y connection thrown over to the 50-cycle mains, whence the observed creep enables the alternator frequency to be found. With a double-beam oscilloscope the two determinations may be combined, using the Y_1 plates for the oscillator and the Y_2 plates for the mains ; there will be a certain amount of mutual interference, but it is not as a rule unduly disturbing. A precision of better than 1 in 1,000 is easily obtained ; the *accuracy* of course depends on how closely the mains frequency is maintained.

A tachometer may be verified by coupling it to an alternator, which is then driven at a succession of speeds to give stationary figures, using the mains as a comparison frequency. The normal speed of the machine should be near the top of the tachometer scale. All the traces of Figs. 3 and 4 have been obtained in this way (turned through 90 deg. since the mains frequency was applied to the X plates). No smoothing was needed for the mains, but the alternator star voltage, of trapezoidal shape with tooth ripples, from an eight-pole 72–slot concentric winding, was reduced to nearly a pure sine by a low-pass filter consisting of a 5-henry series choke and a 1-μF shunt condenser. Traces near the middle of the range are more easily obtained than those near the ends, where the speed intervals are smaller, and Figs. 4 (a) and 4 (w) represent something like the

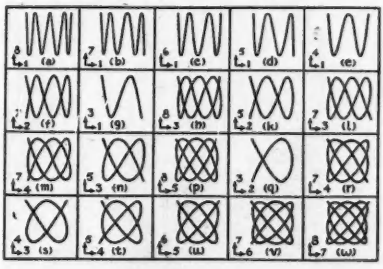


Fig. 4

limit of usefulness for a green screen tube at this base frequency. A pink screen tube with longer afterglow may be expected to extend the limits, provided conditions are sufficiently steady. However, even with the green screen and the speed regulation afforded by the field rheostat of a small shunt motor, enough points are obtainable to provide a satisfactory and highly precise check over a wide speed range. Multi-range tachometers

have rather a bad name for going out of truth, generally on account of careless over-running, and verification by revolution counter and stop watch is somewhat tedious, besides being less precise.

In a retardation test, speeds may similarly be registered by the appearance of their characteristic traces on the screen as the machine runs down. When testing a DC machine by this method it is usually possible to put a temporary earth on one commutator segment, either direct or through a condenser; the requisite alternating voltage is then available between the frame and one brush. Operation on residual flux may require fairly generous amplification. In my view, the value of such a test is not great unless there is sufficient inertia to make the running down a really slow process, but where this condition is satisfied it is worth while making the speed measurements as accurately as possible. The method suggested enables this to be done, and would seem to offer a useful alternative to the employment of stroboscopic apparatus, the choice depending on the equipment that is available.

Mains frequency is not of course the only possible standard. A fixed frequency oscillator or an electrically maintained tuning fork are quite suitable sources, calibrated if necessary by reference to the mains in the first instance. The higher the basic frequency, the more traces can be observed, and the more important it becomes to keep the figure absolutely stationary for observation, which means some nicety in control and really steady conditions. The method is too sensitive to use on fluctuating frequencies; that is the price exacted for its high precision.

If preferred, the synchronised linear time base may be used in any or all of the applications noted, instead of the sinusoidal time base of the Lissajous figures; it is largely a matter of individual choice and familiarity with the traces. The Lissajous method has perhaps some advantage in simplicity and is free from possible error due to the time base falling out of step.

Standard Electric Vehicle

LORD LEATHERS, Minister of War Transport, on Thursday last week inspected the new standard electric vehicle which has been produced by a committee of leading electric vehicle designers under the ægis of the Electric Vehicle Association of Great Britain. The vehicle was shown to the Minister by a deputation from the E.V.A. which was headed by the president, Sir Felix Pole, and included the chairman of the committee, Mr. H. G. Wilson, Mr. A. J. Fippard, vice-chairman; Mr. W. M. Good (Brush Electrical Engineering Co.) and Mr. V. W. Dale, secretary of the Association.

Lord Leathers at the controls of the new standard electric vehicle

The deputation outlined to Lord Leathers the history of the national standard electric vehicle leading up to the production of the prototype which he had inspected, and expressed its confidence in a large potential demand for the vehicle. The vehicle is a considered attempt to organise production of an electric vehicle which can be produced by any manufacturer from standard drawings and plans, in a minimum of man-hours. The finished product, regardless of the particular factory in which it is made, will be interchangeable in every part with any other maker's standard vehicle.

The national standard electric vehicle, which was described in the *Electrical Review* of June 4th last, p. 742, carries a payload of one ton and is rated at 8 HP. It is fitted with a universal body quickly adaptable to individual requirements of side or rear loading. The price, complete with body, but less battery and charger, is quoted (subject to war-time emergencies) at £355. The battery and the charger need not be purchased outright, they can be hired. Like everything else on the vehicle, the four sections of the battery are interchangeable within the vehicle or with those of another machine.

The prototype on protracted tests has shown a mileage of 42 miles per charge, and its "balancing" road speed is 14 m.p.h.

The manufacturers who have co-operated in the production of the vehicle are:—Brush Coachwork, Ltd.; the Brush Electrical Engineering Co., Ltd.; Electricars, Ltd.; the Metropolitan-Vickers Electrical Co., Ltd.; Midland Vehicles, Ltd.; Morrison Electricar, Ltd.; Partridge, Wilson & Co., Ltd. and Victor Electrics, Ltd.

New Year Honours

Well-known Names in List

AMONG the five new barons included in the New Year Honours List are **Sir Thomas Royden, Bt.**, who besides being chairman of the L.M.S. Railway is chairman of Edmundsons Electricity Corporation, Ltd., and **Sir Courtauld Thomson** who is on the boards of the Cable and Wireless group. Another new peer is **Mr. W. Westwood,** a former president of the Engineering and Shipbuilding Trades Federation and of the Confederation of Shipbuilding and Engineering Unions and now chief industrial adviser to the Admiralty.

Of more immediate "electrical" interest are the knighthoods conferred on **Dr. A. H. Railing,** chairman and joint managing director of the General Electric Co., Ltd., and **Mr. G. E. Bailey,** works director, Metropolitan - Vickers Electrical Co., Ltd.; and the award of C.B.E. to **Mr. W. F. Bishop,** a director and former general manager of W. T. Henley's Telegraph Works Co., Ltd. Other new knights are **Mr. T. W. Halcrow,** engineering consultant to the War Office and an authority on water-power and **Mr. W. Paterson,** chairman of the Paterson Engineering Co., Ltd. **Sir Allan Powell,** C.B.E., chairman of the British Broadcasting Corporation, becomes a G.B.E. The C.B.E.'s also include **Mr. W. W. Hackett,** managing director of Accles & Pollock, Ltd., and **Mr. W. Wallace,** managing director of Brown Bros., Ltd.

Sir Thomas Royden (Baron)

Sir Allan Powell (G.B.E.)

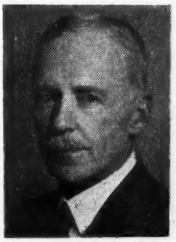
Mr. D. Bellamy, general manager of the Hull Corporation Electricity Department, receives the O.B.E. Awards of the O.B.E. are also made to **Mr. T. D. Hunter** (Eastern Electric Service, Edinburgh); **Mr. T. E. H. P. Kennedy,** superintending mechanical and electrical engineer, Air Ministry; **Mr. A. J. Sheffield,** general manager, aircraft works, English Electric Co., Ltd.; **Mr. O. C. Waygood,** technical adviser, War-time Meals Division, Ministry of Food; and **Mr. F. E. Nancarrow,** Engineer-in-Chief's Office, G.P.O.

The M.B.E. is awarded to **Mr. J. H. Chalk,** works chief engineer, Bakelite, Ltd.; **Mr. H. S. Glass,** chief engineering draughtsman, W. H. Allen, Sons & Co., Ltd.; **Mr. A. Greenfield** (J. & E. Hall, Ltd.); **Mr. D. McNicoll,** works manager, British Timken, Ltd.; **Mr. J. H. Meek,** manager, Scotia Works, Richardsons, Westgarth & Co., Ltd.; **Mr. N. C. Robertson,** director and general works manager, E. K. Cole, Ltd.; **Mr. A. Speight,** works superintendent, Automatic Telephone & Electric Co., Ltd.; **Mr. J. Strachan,** production manager, Consolidated Pneumatic Tool Co., Ltd.; **Mr. C. H. Vaughan,** chief engineer and works manager, Alfred Graham & Co., Ltd.; **Mr. T. R. Porter,** production engineer, Metropolitan-Vickers Electrical Co., Ltd.; and **Mr. B. W. M. Wakefield,** chief tool designer, Rotax, Ltd.

In the long list of men and women who receive the British Empire Medal we notice the following :—Mr. A. W. Babstock (Laurence, Scott & Electromotors, Ltd.), Miss J. Ball (E. K. Cole, Ltd.), F. Connors (Metropolitan-Vickers Electrical Co., Ltd.), Miss R. Hodgson (G.E.C.), Miss E. Hornsey (W. T. Henley's Telegraph Works Co., Ltd.), Mrs. M. R. Jeffries (Aron Electricity Meter, Ltd.), Mr. W. Ludlam (Petters, Ltd.), Mr. A. E. McCleod (G.E.C.), Mr. F. Maisey (B.T.H. Co.), Miss G. Merrington (Ultra Electric, Ltd.), Mr. H. J. Myland (R. B. Pullin & Co. Ltd.), Mr. P. N. Parker (Engineer-in-Chief's office, G.P.O.), Mr.D. Pool (G.E.C.), Mr. H. Russell (Allen West & Co. Ltd.), Miss L. Shaw (Ferranti, Ltd.), Mr. H. J. Sparrow (Evershed & Vignoles, Ltd.), Mrs. B. Stafford (G.E.C.), Mr. H. Taylor (Mullard Radio Valve Co., Ltd.).

Mr. G. E. Bailey (Knight)

Dr. A. H. Railing (Knight)



Mr. W. T. Halcrow (Knight)

Mr. W. F. Bishop (C.B.E.)

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Fulham Payments

IT is interesting to read in your issue of December 24th, that the Staff Committee of the Fulham Borough Council has recommended that a sum of £10,000 should be paid to certain members of the electricity staff for work done out of office hours.

Such work should rightly be remunerated, but what is open to question is the statement that £40,000 has been saved in engineering fees. One wonders if, before arriving at this sum, account has been duly taken of all the expense the Council has been put to in providing accommodation, lighting, telephone, stationery, drawing office and clerical staffs, etc. If not then the figure of £40,000 will require considerable adjustment.

ACCOUNTANT.

Nationalisation

From Mr. Walter Higgs, M.P.—

IN your issue of December 24th you took exception to the concluding paragraph of my letter to *The Times* of December 15th, which was as follows :—

> " Nationalisation is a contentious problem but in my opinion there is a definite line of demarcation between those services which should be nationalised and those to remain in private ownership, in other words, where wayleaves are necessary, nationalisation is desirable. This obviously applies to electricity and it is high time that the ridiculous difference in charges for the same supply was entirely abolished and current made available to all as advocated in the Scott report."

I regret that my good friend Sir Herbert Williams sees fit to differ from me but I have no intention whatever of re-examining the problem as you suggest or of altering my opinion in any way.

Sir Herbert opposes nationalisation, compares electrification with the telephone, and says that the average cost of a call has doubled since 1914. A weaker argument would be hard to find. Although we have a grid all over the United Kingdom electricity is not generated in London and distributed in Glasgow and obviously the cost is in proportion to the distance covered. In other words if the average length of call is increased then the cost must rise. I cannot understand the opposition to nationalisation for opposition's sake. The word is poison to some people and they leave it at that.

The opponents of nationalisation on principle remind me of the man who boards a corporation tram along a public highway to the park and after refreshing himself at a British Restaurant, goes to the nearest public library to complete his case against nationalisation and then uses the telephone to inform a friend of his views.

I advocate nationalisation of distribution with the sole object of obtaining a uniform tariff for current for any specific purpose throughout the country and access to supply. It is not necessary for me to enlighten the electrical fraternity of the present chaotic state of charges; such a scheme would increase the price to town and urban consumers but this would be apparent rather than real because with the additional demand for equipment industry would benefit.

It is not constructive criticism for a member of the House of Commons to blame Acts of Parliament over sixty years old. It is his duty to assist in bringing them into line with modern requirements.

Witton, Birmingham. WALTER HIGGS.

Boiler Flue Losses

FOR many years the accepted way of estimating the loss of heat in boiler flue gases has been by means of the Siegert formula, which is direct and simple, and complete analysis of the fuel is not necessary. While it is a reasonably accurate method, it has lately seemed desirable to strive for accuracy of a higher order. But before discarding the Siegert method the extent to which it is deficient should be ascertained.

Accordingly, in the paper by Mr. E. L. Luly presented to the Institute of Fuel in London the heat content of the products of combustion is examined by generalising the problem in order to obtain the simplest possible expression consistent with accuracy; and then endeavouring to ascertain whether in the absence of an ultimate analysis, numerical values can be assigned with reasonable certainty to certain properties of the fuel.

The comparative data presented by the author indicate that the continued use of the more simple Siegert type of formula is fully justified, provided that the loss so computed is regarded as a percentage of the gross calorific value (not of the net value as hitherto) and that it is deemed to be applicable to dry gases only (not to wet gases). When the results of an ultimate analysis are available a more exact formula derived by the author may be employed for assessing the sensible heat in dry gases.

Radiator Efficiency

The importance of keeping the reflectors of electric fires highly polished is emphasised in the January issue of " Cheerful Rationing " published by the Electrical Association for Women.

PERSONAL and SOCIAL

News of Men and Women of the Industry

IN the presence of a large number of employees of Kettering Electricity Department the retiring engineer, **Mr. W. A. Walker,** was presented with a silver cigarette case and gold cuff links at the works on December 23rd. Unfortunately Mr. C. Binns, Mr. Walker's successor, was indisposed, and so the presentation was made by Mr. F. J. Broadley, mains engineer and chairman of the works committee. Mr. Walker expressed his gratitude to the staff for their loyalty.

At a meeting of the Town Council on the same day several members expressed their personal appreciation of Mr. Walker's services, the chairman of the Electricity Committee, Councillor W. Woodcock, stating that Mr. Walker came to Kettering before the supply was switched on in the town, and that, through his special technical knowledge, administrative ability and business acumen, he had raised the undertaking to the high and important position it held to-day. In his reply Mr. Walker mentioned the fact that the area of supply of the undertaking now covered 170 sq. miles with 23,000 consumers.

Lieut. (E.) J. N. Campling, R.N., who is on the staff of Preece, Cardew & Rider in civilian life and is a son of Mr. P. G. Campling, chief electrical engineer of Bedford, has been awarded the M.B.E. for enterprise and skill in repair work after his ship had been bombed in connection with the operations which led to the capture of Sicily.

On the retirement of **Mr. J. B. Hudson** from the District Council (No. 3) North Western Area and the District Joint Board (No. 3) North Western Area, **Mr. P. Clegg,** borough electrical engineer of Macclesfield, was appointed a member of the Council and Board for the ensuing year.

Alderman W. Sowter, M.B.E., J.P., chairman of the Bedford Corporation Electricity Committee, is to be made an honorary freeman of Bedford in recognition of his distinguished public service for many years past.

Mr. J. H. Charnley, for many years Manchester sales manager for Lancashire Dynamo & Crypto, Ltd., has resigned his position to represent the Electric Construction Co., Ltd., in Lancashire and Cheshire. His address is 16, John Dalton Street, Manchester, 2.

Mr. A. W. Robins entered the employ of Siemens Bros. & Co., Ltd., in November, 1893, and to mark the completion of fifty years' unbroken service he has been presented with a cheque by Mr. G. W. Giffin, works manager, on behalf of the company. Mr. Robins is now in charge of all cable stores, having held this position since 1937.

Mr. A. H. Brown, A.M.I.E.E., formerly assistant telephone manager in Glasgow, has been appointed telephone manager for West Scotland. Mr. Brown spent a number of years in the south of England and in the London office of the Engineer-in-Chief of the Post Office. Since returning to Glasgow he has been on the staff of the superintending engineer (Scotland, West District), and he was responsible for the installation of the automatic exchanges in the city.

Mr. S. C. Ginno, A.M.I.E.E., who for the past fifteen years has been with the Leicester Corporation Electricity Department as sales manager, has resigned his position to join Oxy-Ferrolene, Ltd., as sales manager and development engineer.

Mr. Angus A. Fulton, B.Sc., Dundee Corporation water engineer since 1938, has been appointed hydraulic engineer to the North of Scotland Hydro-Electric Board. He is forty-two. Before joining Dundee Corporation he had been with Boving & Co., Ltd., since 1923 and had travelled extensively abroad in connection with the company's contracts.

Mr. David Watt

Mr. David Watt, B.Sc., A.M.I.E.E., has been appointed London district sales manager of Lancashire Dynamo & Crypto, Ltd. Mr. Watt was educated at Glasgow Academy and Glasgow University and served an apprenticeship with Watson Laidlaw & Co., Ltd., Glasgow, and the Lancashire Dynamo & Motor Co., Ltd., Manchester. He joined the London office of L.D.C., Ltd., in 1928.

We regret that in our reference to the retirement from the command of the First Canadian Army of **Lieut.-General A. G. L. McNaughton** last week we said that he was an associate member of the I.E.E. He was, of course, elected an honorary member in 1942.

Mr. A. R. Clague, M.Eng., A.M.I.Mech.E., assistant power station superintendent in the Belfast undertaking, was recently appointed assistant generating engineer to the West Midlands J.E.A. He takes up his new duties on February 1st.

At the annual meeting of Ensign Lamps, Ltd., last week, **Mr. W. V. Green** stated that, in addition to himself as chairman and managing director, the board of the company now consisted of Messrs. F. T. Green, J. W. Green and E. K. Cole (deputy-chairman and joint managing director of E. K. Cole, Ltd.). The former chairman, Mr. G. W. Fletcher, had resigned from the board.

Belling & Lee, Ltd., celebrated their twenty-first anniversary on December 20th. The occasion was anticipated on the previous Saturday, when the company entertained employees to dinner, followed by an E.N.S.A. concert and dancing. During the evening a presentation was made to **Mr. E. M. Lee,** B.Sc., A.M.I.E.E., director and general manager, on behalf of employees of over ten years' service. Mr. Lee, in acknowledging this gift, reviewed the

history of the company from early days as very small founder members of the British Broadcasting Company, through an expansion of 26 to 1 in factory space and 200 to 1 in personnel, the first year's turnover now being accomplished in 1½ hours. He looked forward to making "a splash" when peace came again. **Mr. C. R. Belling,** M.I.E.E., director, was unavoidably absent following a recent accident.

The Finchley Corporation is asking for the return of **Lt.-Col. C. R. Westlake** to his civil duties. Lt.-Col. Westlake, who is the general manager and engineer of the Corporation's electricity undertaking was released for special military duties early last year.

Mr. S. F. S. Whitehouse, B.Eng., B.Sc., A.M.I.E.E., has left the Yorkshire Electric Power Co. to take up an appointment as technical assistant to the manager of the Cambridge Electric Supply Co., Ltd. He was married last week to Miss Margaret Brotherton, the daughter of Mr. and Mrs. Gildart Brotherton, of St. Martins, Salop.

At the Helsby works of British Insulated Cables, Ltd., **Mr. G. H. Walton,** manager, recently made presentations to five employees who have just completed fifty years' service. Each received a wallet containing treasury notes for £50.

Obituary

Mrs. F. Winstanley.—We are very sorry to learn that Mrs. Ethel Winstanley, the wife of Mr. F. Winstanley, a director of the General Electric Co., Ltd., and manager of the company's fixtures and domestic appliances department, died at their home at Weybridge on December 31st.

Mr. W. H. Starkey.—We regret to record the death of Mr. William H. Starkey, A.M.I.E.E., for many years district engineer of the Tudor Accumulator Co., Ltd., for London and the Eastern Counties. He joined the company in 1902.

Councillor Hilder Strange, chairman of the Manchester Corporation Electricity Committee, has died at Deganwy, North Wales, at the age of sixty-four.

Mr. Curtis Veeder.—The *Associated Press* reports that Mr. Curtis Veeder, inventor, manufacturer and designer of the first electric locomotive operated in the United States, has died at the age of eighty-one.

Mr. John Gilbert, a native of Moray, Scotland, who has died at Cape Town in his ninetieth year, emigrated in 1878 and was a pioneer in the construction of telegraph lines in South Africa. During the siege of Kimberley he was superintendent of Army telegraphs.

Mr. A. T. Eardley, general manager of the Stockport Corporation Transport Department from 1904 until his retirement in 1936, has died at the age of seventy-two.

Mr. A. E. Coombs, whose death has occurred at the age of sixty-four, was formerly Post Office telephone manager for the Glasgow area. He entered the service of the old National Telephone Co. in 1900 and was transferred from Liverpool to Glasgow as telephone superintendent in 1925, being promoted manager ten years later. Shortly after he retired in 1941 he became a member of Glasgow City Council.

Forthcoming Events

Institution of Electrical Engineers.—Monday, January 24th, 5.30 p.m. Informal discussion on "Industrial Applications of Radio-Frequency Methods of Heating," to be opened by Mr. N. R. Bligh.

Wireless Section.—Tuesday, January 18th, 5.30 p.m. Discussion on "Comparative Merits of Different Types of Directive Aerials for Communications," to be opened by Mr. J. A. Smale, B.Sc.

Measurements Section.—Friday, January 21st, 5.30 p.m. "A New Electronic Stabiliser and Regulator for DC Voltages," by Mr. A. Glynne, M.A.

Scottish Centre.—Wednesday, January 12th, 6 p.m. Heriot-Watt College, Edinburgh. The Future of the Domestic Wiring Installation. Section 1 "Immediate Developments," by Messrs. W. J. H. Wood and Forbes Jackson, and Section 2 "The Distant View," by Messrs. G. Smith and E. Jacobi.

West Wales (Swansea) Sub-Centre.—Saturday, January 15th, 3 p.m. Guildhall, Swansea. "Air-Blast Circuit Breakers," by Mr. A. R. Blandford.

Mersey & North Wales (Liverpool) Centre.—Wednesday, January 19th, 6 p.m. Municipal Annexe, Dale Street. "Electric Lamp Manufacture and Development," by Mr. A. L. Randall.

North Midland Students' Section.—Saturday, January 15th, 2.30 p.m. Griffin Hotel, Leeds. "Recording of Disturbances on Electrical Supply Systems," by Mr. W. T. J. Atkins, B.Sc., Centre chairman.

London Students' Section.—Monday, January 17th, 7 p.m. Problems Night.

North-Western Students' Section.—Thursday, January 20th, 7 p.m. Gas Showrooms, Chester Road, Stretford. Film evening.

Association of Supervising Electrical Engineers.—Saturday, January 8th, 2.15 p.m. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2. Address by Mr. W. J. Jones (E.L.M.A.) on "Lighting at Present and Post-War Possibilities" (instead of lecture by Mr. J. L. S. Baxter).

Association of Mining, Electrical & Mechanical Engineers.—*West of Scotland Branch.*—Saturday, January 8th. "Design of Electrical Apparatus for use in Inflammable Atmospheres with particular reference to the Coal Mining Industry," by Mr. A. P. Harvey.

Derby Society of Engineers.—Monday, January 10th, 6.30 p.m. School of Arts Lecture Theatre, Green Lane. "Lighting as an Aid to Wartime Production," by Mr. T. Catten (B.T.H. Co.).

Junior Institution of Engineers.—Friday, January 14th, 6.15 p.m. 39, Victoria Street, London, S.W.1. "Tidal Power," by Mr. R. H. Abell, M.I.E.E.

Sheffield Section.—Saturday, January 15th, 2.30 p.m. Central Library, Surrey Street. "The Synchrophone as an Aid to Post-War Training," by Mr. N. Sandor, M.I.Mech.E., A.M.I.E.E.

Institute of Fuel. — *London.* — The meeting arranged for Thursday, January 20th, has been cancelled.

Manchester.—Wednesday, January 12th, 2.30 p.m. Engineers' Club, Albert Square. Résumé of Melchett Lecture by Dr. E. S. Grumell, C.B.E.

Power Companies' Plan

Memorandum Criticised by London J.E.A.

AT yesterday's meeting of the London and Home Counties Joint Electricity Authority a report was submitted on the recent memorandum published by the Incorporated Association of Electric Power Companies (*Electrical Review*, December 3rd, p. 741). This report, which is signed by Mr. I. J. Hayward, vice-chairman of the General Purposes Committee, and Mr. Leslie Gordon, Clerk and Solicitor to the Authority, briefly describes the nature of power companies, with particular reference to their subsidiary powers of distribution and the purchasability of such parts of their undertakings as are in the areas of local authorities.

The Association's proposal that purchase rights shall be suspended for at least fifty years, without prejudicing schemes for the voluntary acquisition or amalgamation of undertakings, is referred to. The Association pointed out that the McGowan Committee considered that the essential features of any scheme for the improvement of distribution must include the prevention of the splitting up of comprehensive undertakings in consequence of the exercise of purchase powers by individual local authorities.

Expiry of Orders

The J.E.A. report states that most of the Orders under which the companies are operating will expire in the comparatively near future ; in fact many have expired and are being continued on a more or less temporary basis. " The Association does not, apparently, support the Authority's proposal, which the circumstances seem so obviously to suggest, that appropriate public authorities should be established on such a basis as would enable the purchase rights to be exercised, as contemplated by Parliament, so as to avoid the splitting up of comprehensive undertakings."

It was suggested by the Association that the larger undertakings should be allowed to acquire the smaller ones. Company undertakings would be acquired on the ordinary commercial basis of to-day, assets plus profits, or by purchase of ordinary shares, and payment to local authorities would not exclude a sum for loss of profits. Such terms, it is thought, must lead to increased capitalisation which must affect the price of electricity to consumers. The report holds that the extension of the tenure of acquired undertakings by not less than fifty years would automatically and immediately increase the value of the combined undertaking to a very considerable extent and any subsequent scheme for the transfer of the combined undertakings to a public authority would involve the payment of a very largely increased goodwill value.

While, the report says, the Association recognises the principle running through all legislation since 1882 of ultimate public ownership " it fails to explain whether, and if so how, a transfer of all undertakings to public ownership would be less onerous in fifty years' time than it is now." It also fails to refer to the opportunity which is now presented of obtaining capital at cheap rates to enable transfer to take place to a public authority at the least cost to the public.

Comparison of Charges

Finally, it is contended that there is every likelihood that the public would lose by the power companies' proposals, as compared with the proposals submitted by the Authority. An appendix to the report compares the average selling prices of electricity (in 1937-38) by public authorities and companies to show that the average price per kWh for domestic supply was 1·529d. in the case of public authorities, 2·01d. in the case of power companies, and 2·077d. for all companies. For domestic purposes local authorities supply 70·02 per cent. of the total, power companies 9·67 per cent. and other companies 20·31 per cent.

In the case of power supplies the prices are as follows :—Public authorities (58·8 per cent.), 0·642d. per kWh ; power companies (28·39 per cent.), 0·610d. ; other companies (12·81 per cent.), 0·720d. For all energy sold, excluding bulk supplies, the following prices are given :—Public authorities (63·13 per cent.), 1·028d. ; power companies (19·95 per cent.), 0·877d. ; other companies (16·92 per cent.), 1·330d. It is estimated that domestic consumers numbered rather more than 86 per cent. of the total. " Domestic " supply, on the figures given, represented about 38 per cent. of the total energy sold.

Portable-Tool Protection

WHAT is known as the Butcher-Black & Decker system of earth protection against electric shock for portable drills and similar hand tools used in factories and for general engineering work is the subject of a series of descriptive leaflets, which explain the scheme in language that is understandable both by laymen and technicians, issued by Electro-Methods, Ltd., 112, Brent Street, Hendon, London, N.W.4, which is now manufacturing and marketing the necessary equipment on a commercial basis. The principles underlying this system were described by Mr. F. E. Butcher in the *Electrical Review* of July 11th, 1941.

Impedances in Parallel

A Graphical Method of Solution

By N. H. Barker,
A.C.G.I., A.M.I.E.E.

THE parallel value of two impedances with different phase characteristics, is given by

$$Z_p = \frac{Z_1 Z_2}{\sqrt{(R_1+R_2)^2+(X_1+X_2)^2}} = \frac{Z_1 Z_2}{Z_1+Z_2} = \frac{\text{product}}{\text{vector sum}} \quad \ldots\ldots(1),$$

where R_1, X_1, Z_1 and R_2, X_2, Z_2 are the resistance, reactance and impedance of the two vectors considered and Z_p the parallel value.

Resistances or reactances in parallel are the particular case of vectors which are in phase and the vector sum is the algebraic sum. The parallel value then becomes the usual formula $R_p = \frac{R_1 R_2}{R_1+R_2} = \frac{\text{product}}{\text{sum}}$.

Adapting the usual geometrical construction for parallel values to two vector impedances which differ in phase, the construction shown in Fig. 1 is obtained. From this diagram, $\frac{Z_p}{Z_2} = \frac{Z_1}{Z_1+Z_2}$, $\therefore Z_p = \frac{Z_1 Z_2}{Z_1+Z_2}$

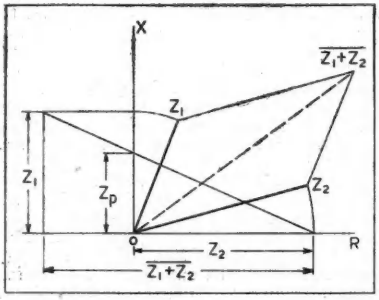


Fig. 1

This construction gives the magnitude but not the phase of the parallel value Z_p. The equivalent resistance and reactance values of Z_p can be easily obtained and are

$$R_p = Z_p^2\left(\frac{R_1}{Z_1^2}+\frac{R_2}{Z_2^2}\right) \quad \ldots\ldots(2)$$

$$X_p = Z_p^2\left(\frac{X_1}{Z_1^2}+\frac{X_2}{Z_2^2}\right) \quad \ldots\ldots(3)$$

If ϕ_p is the phase angle of the parallel impedance vector, then from equations (2) and (3) we have

$$\cos\phi_p = \frac{R_p}{Z_p} = \frac{I}{Z_1+Z_2}\left(Z_2\cos\phi_1 + Z_1\cos\phi_2\right)$$

or $\overline{Z_1+Z_2}\cdot\cos\phi_p = Z_2\cos\phi_1 + Z_1\cos\phi_2$ . . (4)

Combining the construction in Fig. 1 and using equation (4), the construction in Fig. 2 gives both magnitude and direction of the parallel value of Z_1 and Z_2, *i.e.* the vector Z_p.

Referring to Fig. 2, $OC = Z_2$, $EF = Z_1$. Make $EC = \overline{Z_1+Z_2}$. Then as in Fig. 1, $OG = Z_p = \frac{Z_1 Z_2}{Z_1+Z_2}$.

Referring to equation (4) and Fig. 2,

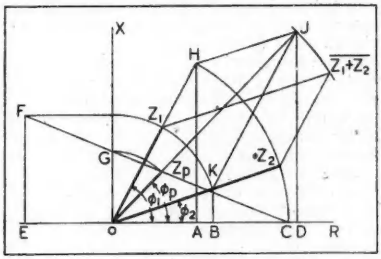


Fig. 2

$OA = Z_2\cos\phi_1$ and $OB = Z_1\cos\phi_2$. Make $OD = OA + OB = Z_2\cos\phi_1 + Z_1\cos\phi_2$ and make $OJ = \overline{Z_1+Z_2}$.

Then OD also $= \overline{Z_1+Z_2}\cos\phi_p$.

From equation (4), ϕ_p is the phase angle of the parallel impedance vector and OZ_p represents the vector Z_p both in magnitude and direction.

The parallelogram OHJK when completed is the reflection of the parallelogram OZ_1, $\overline{Z_1+Z_2}$, Z_2; hence, the diagonal OJ is the reflection of the vector $\overline{Z_1+Z_2}$.

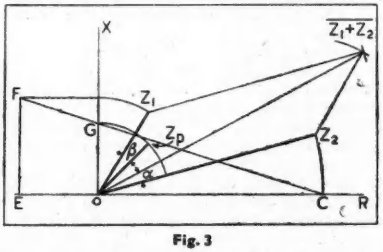


Fig. 3

Hence the phase of Z_p is the same as the reflection of the vector $\overline{Z_1+Z_2}$.

The simplified diagram is shown in Fig. 3, where $\angle\alpha = \angle\beta$, where the scale of R = the scale of X.

COMMERCE and INDUSTRY

Tory Industrial Policy. Grid Charges

Red Cross Appeal

THE organisers of the Electrical Industries Red Cross Appeal have issued a seventeenth list of contributions which shows that the aggregate amount subscribed to date is £17,620 10s. 6d. The list acknowledges a covenanted subscription of £15 from Hunt & Co. (Newark), Ltd., and the following donations:—West Devon Electric Supply Co., Ltd., £5; Weatherhead's, £1 1s.; and H. Beney & Sons, Ltd., £1 1s.

Cable v. Wireless

Sir Ernest Fisk, chairman of Amalgamated Wireless (Australasia), Ltd., stated last week that since 1928 the development of beam radio in Australia had been severely restricted in order to protect the revenues of the cable companies. Replying to this the Australian Postmaster-General (Senator W. P. Ashley) said that there was not yet sufficient evidence to support the view that radio-telegraphy had obtained complete superiority. The whole subject would be exhaustively discussed in London early in 1944. Sir Ernest's remarks had been unduly critical and were likely to create an unbalanced appreciation of the Empire's communications system. Cables, although slower than radio, gave a 24-hour service with completely secret transmission, whereas radio was subject to fading and other interruptions due to atmospheric causes which had not been entirely overcome. The Empire, on the advice of the Service chiefs, kept the cables going because they regarded them as vital in wartime and they carried an enormous load with commendable despatch.

Grading in the Engineering Industry

The *Press Association* Labour Correspondent states that the conference between the Engineering Employers' Federation and the engineering trade unions on grading is not likely to be resumed until about the middle of this month. The Federation in the meantime is preparing a detailed reply to the unions' claim.

The discussion and decision are likely to have a far reaching effect on the future wage basis of all men and women in the industry. The employers, it is understood, have no objection to a grading scheme providing a national agreement can be worked out on practical lines.

Engineering Clerks' Overtime Claim

The National Arbitration Tribunal has rejected a claim made for overtime rates for clerical and administrative workers in the engineering industry. The Clerical and Administrative Workers' Union claimed that the Engineering and Allied Employers' National Federation should recommend all federated firms to compensate their clerical and administrative staffs for all overtime worked on the following basis: time-and-a-third for first two hours; time-and-a-half after the first two hours up to midnight; double-time thereafter, and on Saturday afternoons and Sundays. The Tribunal stated that its decision was without prejudice to the Union's right on behalf of the workers to claim application of the provisions of the "Manchester" agreement of July 24th, 1941, relating to overtime, or of similar provisions in all or any of the districts in which such provisions do not apply.

C.E.B. Tariffs

The periods initially fixed for the grid tariffs for the South East England, East England, North West England and North Wales and Central England Electricity Schemes having expired on December 31st, 1943, the Electricity Commissioners have approved under Section 11 of the Electricity (Supply) Act, 1926, proposals made by the Central Electricity Board to continue the same tariffs for a further budgetary period of two years from January 1st, 1944. Tariffs for the Mid-East England, Central Scotland and South Scotland Schemes have already been extended as from the beginning of last year for a further three years.

Electrical Benevolence

The sum of £124 has been added to the funds of the Electrical Industries Benevolent Association from the sale of a fully rigged fifteenth-century galleon made by a Scottish craftsman and presented by Mr. H. G. McKerron, chairman of the Glasgow branch, at a meeting of representatives in the Electricity Showrooms. The new owner of the model is Miss M. McArthur, an employee of the Glasgow Corporation Electricity Department.

The annual general meeting of the Northern Counties Area of the Electrical Industries Benevolent Association will be held on Monday, January 24th at 3.30 p.m. at Tilley's Restaurant, Blackett Street, Newcastle-upon-Tyne, 1, under the chairmanship of Lieut.-Col. E. H. E. Woodward.

Future of British Industry

It is natural that private enterprise in industry should be considered superior to national ownership and operation by the Conservative Sub-Committee on Industry in its report published this week (Conservative and Unionist Party Organisation, 24, Old Queen Street, S.W.1, price 6d.). This report, bearing the title "Work: The Future of British Industry," covers a wide range of subjects in its 47 pages. It is maintained that industrial progress has resulted from individual inventiveness and enterprise and that nationalisation of industry does not offer security and is likely to produce harmful political interference. Public corporations are not generally favoured, although it is admitted that there have been one or two examples of success. The abuse of monopoly should be prevented by the State. Voluntary trade associations are considered to be valuable mouthpieces for their industries.

The importance of export trade is emphasised and exporters are urged to keep ahead of market

requirements and the Government Departments concerned to give evidence of a more practical understanding of exporters' needs and difficulties.

In dealing with conditions of employment, the Sub-Committee deprecates the continuation of the Essential Work Orders (there is more than one) after the war as they restrict personal liberty. There are features of the Orders which it would be desirable to retain in order to ensure satisfactory conditions for the workers. Trade unions are realised to be a part of the industrial structure but compulsory membership is considered undemocratic. The position of women in industry is discussed. Equal remuneration for equal work and the opening of the highest posts to women are recognised as just but there is a suggestion that, in general, women will never become industrially equal to men.

International collaboration is given attention, particular reference being made to currency plans, temporary credits, price stabilisation, and the raising of the status of backward peoples.

Fuel Economy

With a view to assisting managements of industrial concerns towards an immediate saving of coal, the Fuel Efficiency Committee of the Ministry of Fuel and Power has compiled material making appropriate suggestions. Although the use of electricity as such is immune from most of the possible troubles enumerated in the questionnaire, the references it contains to Ministry Bulletin numbers will no doubt be useful to those with small steam generating plants. Attention is drawn to an important aspect of space heating, *viz.*, that if the minimum temperature necessary is exceeded by 1 deg., 5 per cent. more fuel is burned. A case is cited of a factory in which 145 tons of fuel were saved last winter through the installation of thermostatic control at a cost of £250. This supports the detailed conclusions worked out by Mr. R. Grierson in articles on electric boilers for space heating which have appeared in the *Electrical Review* during the last twelve months or so.

Conference on X-ray Analysis

The third conference on X-ray analysis in industry has been provisionally arranged to take place at Oxford on March 31st and April 1st under the auspices of the X-ray Analysis Group of the Institute of Physics. Details will be circulated shortly to members of the Group and will be sent to non-members on application to Dr. H. Lipson, honorary secretary of the Group, c/o Crystallographic Laboratory, Free School Lane, Cambridge. The conference will be open to all interested, but it may be necessary to limit the number of non-members of the Group for whom accommodation can be provided.

Linesman's Appeal Dismissed

The Supreme Court of Eire, by a majority decision, has dismissed the appeal of Mr. John Walsh, a linesman, from a verdict in favour of the Electricity Supply Board in a claim for damages for injuries received through coming in contact with a live wire. The trial judge held that Mr. Walsh was precluded from bringing the proceedings because he had exercised his option to claim under the Workmen's Compensation Act.

The Chief Justice, Mr. Justice Murnaghan and Mr. Justice O'Byrne agreed that the judge was correct. Mr. Justice Black dissented. He said the onus was on the Board to prove that Mr. Walsh had exercised his option, but the question had never been put to Mr. Walsh. The question should have been left to the jury.

Excessive Charge for Refrigerator

At the Brighton Police Court on December 23rd, Gustave W. Lindeck, electrical goods dealer, was fined £25 for selling a second-hand electric refrigerator for £70 when the original price was £35 14s. For failing to keep a stock record as a second-hand dealer he was fined a further £10 and ordered to pay £15 towards the costs of the prosecution.

The Story of Coal

Interesting facts about coal are contained in a 16-page booklet entitled "The Story of Coal" issued by the Coal Utilisation Joint Council, 54, Victoria Street, London, S.W.1. Written in non-technical language and excellently illustrated, the booklet describes how coal is formed, how seams are discovered, shaft sinking and laying out the mine, coal cutting and haulage, cleaning and preparation. Attention is drawn to the part played by electricity, not only in cutting the coal, conveying and hauling it to the surface, but also in the lighting and ventilation of the mines. The fact is also mentioned that in peacetime about 33 million tons of coal a year are used to produce electricity and gas.

Supervisors' Union Recognised

The Association of Supervisory Staff and Engineering Technicians has signed a recognition agreement with the Engineering and Allied Employers' Federation. Mr. T. Agar, General Secretary of the Association, informed the *Press Association* that this was the first time that foremen, superintendents, planning engineers, technicians and all grades for whom the union caters had the right to be represented in negotiations by their appropriate trade union. It was 25 years since the first approach was made on this question, he said. One of the complications arising from non-recognition was the fact that these grades of key men were not represented on joint production committees. Now members of the Association would have the right to sit upon production committees. Functionally speaking, they were on the management side of industry. The agreement came into operation on January 1st.

Tin Price Increase

As from January 1st the price of tin sold by the Non-Ferrous Metals Control has been increased by £25 per ton. The price for metal of minimum 99 per cent. up to under 99·75 per cent. tin content will be £300 per ton and all other prices will be varied correspondingly. The former price had been in operation since December 9th, 1941. Since that date there has been a general upward movement in the cost of tin to the Ministry of Supply, resulting in a substantial burden on public funds at the present price, and the increase now announced takes account of the present and anticipated level of costs of the supplies from the different sources

available to the Ministry while the present abnormal conditions in the Far East continue.

Holders of licences to purchase tin granted on or before December 31st, 1943, can, on application to the Joint Controllers, Non-Ferrous Metals Control, Grand Hotel, Rugby, cover themselves by purchases, where they have not already done so, against such licences up to and including January 8th, 1944, at the Ministry of Supply's selling prices ruling on December 31st, 1943.

Workmen's Compensation Tables

In our December 24th issue Mr. F. E. Sugden reviewed the changes in allowances made by the Workmen's Compensation (Temporary Increases) Act. We have now received from Stevens & Sons, Ltd., 119, Chancery Lane, W.C.2, a copy of their tables of weekly compensation as increased by the Act (3s. 6d. net), compiled by Mr. H. Morgan Hughes, A.C.I.I. The bulk of these relate to total incapacity and are set out according to the various categories in which injured men may be placed, *i.e.*, married or unmarried, with or without children. Examples show the manner of applying the tables and there are full explanatory notes.

Wheat Drying

Referring to the article on "Wheat Drying" in our last week's issue, Lancashire Dynamo & Crypto, Ltd., inform us that the motors employed in the installation described are all of their manufacture. Several repeat orders for other similar plants have also been received.

Dissolution of Partnership

Mr. H. Brown and Mr. L. Brown, trading as Brown Brothers, electrical contractors and electrical suppliers, at 185, North Street, Leeds, have dissolved partnership. Mr. L. Brown will attend to debts and will continue to carry on the business under the style of Brown Brothers.

Belfast Electricians' Wages

Under an award of the National Arbitration Tribunal electricians employed by the Belfast Corporation are to receive a penny an hour above the district rate. The increase puts them on a similar basis to fitters, machinists and turners employed by the Corporation.

Fatalities

Geoffrey Charles Richard Evans (22), of Tettenhall, was stated at a Wolverhampton inquest to have received a fatal electric shock while handling an electric drill. Evidence was given that there was no plug at the end of the flex attached to the drill. The bare wires were projecting and Evans had worked for some time with the drill in that condition. A verdict of "Accidental death" was returned and the coroner asked Mr. R. N. Walker, who represented the Midland Metal Spinning Co., Ltd., to emphasise the risk that was run, The methods the company adopted were not entirely right, and there must be some tightening up in maintaining instruments in use.

An inquest was held recently on a twenty-year-old farm labourer, Bertie Albert Ernest Knight, who was found dead in a field holding in his charred hand a piece of rope used to join the towing wire to an R.A.F. practice target. Evidence was given by Mr. Leslie Gill, linesman, that after he had been informed of a failure of supply he found that two high-voltage fuses had blown. He patrolled the line and saw two dead bullocks in a field, with a piece of burnt wire close by. The voltage would have been about 6,300. The coroner returned a verdict that death was due to electric shock caused by the wire from an R.A.F. towing target coming in contact with the main electricity supply. No blame attached to the pilot or his drogue operator.

Calendars

A useful "At-a-Glance" calendar with a movable indicator and monthly sheets has been sent to us by Mr. Francis C. Polden, of Francis Polden & Co., Ltd.

The 1944 calendar of Fitter & Poulton, Ltd., with monthly sheets, is tastefully decorated by a picture entitled "One of his Best," showing an artist regarding his work.

Photographs of their equipment, and details of their principal manufactures are given in the calendar with three-monthly sheets which we have received from Ruston & Hornsby, Ltd.

Refills for the Chloride Electrical Storage Co.'s desk calendar and diary stands are now available.

A picture of one of the company's motors against a background of a Union Jack decorates the Brook Motors calendar, which has sheets showing the current, preceding and following months.

An illustration of the company's life-jacket light appears on the Easco Electrical Services' calendar which has monthly tear-off sheets.

The Davenport Engineering Co.'s calendar has monthly sheets which also show the preceding and next months.

"My Brother and I" is the title of the Automatic Telephone & Electric Co.'s calendar, which depicts "Patricia," one of the company's employees, adjusting relays for telephone equipment for the use of the Services.

Johnson, Matthey & Co's. calendar has daily tear-off slips with quotations.

Trade Announcement

Ferguson, Pailin, Limited have moved their London office to Hastings House, 10, Norfolk Street, Strand, W.C.2 (telegraphic address: "Ferpacolin, Phone, London"; telephone, Temple Bar 8711/2).

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the makers of the following:—

TURBINIA electric hair dryers (W. H. Martin Electrics ?).

News from America

Wind and Water Power. Coal Position Deteriorating.

Harnessing the Missouri

AN ambitious project for the development of the Missouri River basin was described by Mr. W. E. Warne, assistant commissioner, at the annual convention of the North Dakota Reclamation Association, states the *Electrical World*. The scheme, which the Bureau of Reclamation was prepared to undertake in co-operation with the Corps of Engineers of the War Department, would, he said, provide for the irrigation of about 4,400,000 acres of arid and semi-arid land and heads would be created by the dams for driving 952,000 kW of power plant. Flood protection would be provided along the Missouri and there would also be beneficial effects further down the Mississippi.

Grand Coulee Capacity Increased

The seventh 108,000-kW generator at the Grand Coulee Dam has been put into commercial operation, raising the installed capacity of the plant to more than 700,000 kW.

Wind-Turbine Generator

Members of the Connecticut Section of the American Institute of Electrical Engineers were told last month that after several weeks' stoppage for mechanical changes the Smith-Putnam 1,000-kW wind turbine had been put back into commercial operation on the Central Vermont Public Service System at Grandpa's Knob. An assurance was given by Prof. J. B. Wilbur, chief engineer, and Mr. W. M. Edson, superintendent of operations, that the venture was satisfying its sponsors. Since completion in 1941 the unit has operated for about 700 hours and has produced 300,000 kWh. Being still experimental, much time has been devoted to improvements (oil system of the hydraulic coupling, governor sensitiveness, yaw mechanism, coning struts and main roller bearing). Electrical difficulties have been relatively few.

Rural Electrification

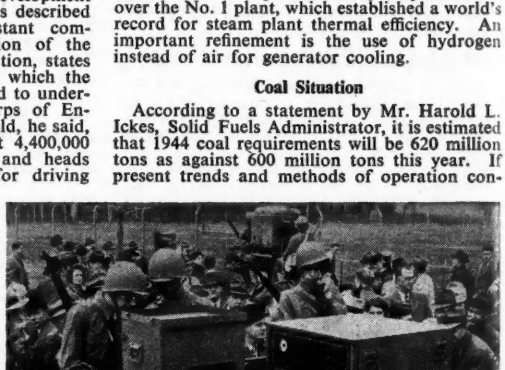
At a recent Georgia meeting Mr. W. J. Neal, Deputy Administrator, Rural Electrification Administration, stated that the R.E.A.'s post-war plans aimed at a construction programme of over $500 million in the first three years. According to a statement by Mr. H. Slattery, R.E.A. Administrator, farms which at present have no public electric service number 3,642,699.

Port Washington Extension

A second 80,000-kW set has been commissioned at the Port Washington station of the Wisconsin Electric Power Co. The new unit is housed in an addition to the original plant building and operates with steam at 1,250 lb./sq. in. and 850 deg. temperature. According to Mr. S. B. Way, president of the company, this No. 2 unit incorporates many improvements over the No. 1 plant, which established a world's record for steam plant thermal efficiency. An important refinement is the use of hydrogen instead of air for generator cooling.

Coal Situation

According to a statement by Mr. Harold L. Ickes, Solid Fuels Administrator, it is estimated that 1944 coal requirements will be 620 million tons as against 600 million tons this year. If present trends and methods of operation continue it is not considered that the industry will be able to produce even as much as during the past year.



This photograph from the United States shows a demonstration given in the grounds of the Bell Telephone Laboratories, Murray Hill, N.J., of a tracker and electrically-controlled computer for an anti-aircraft gun

Between January, 1943, and the beginning of September coal stocks were reduced by 10,597,000 tons whereas in the corresponding period of 1942 they were increased by 19,949 tons. During August last the daily average consumption of coal by electric utilities was 223,355 tons, an increase of 6 per cent. over July. Utilities' coal stocks were reduced during the month from 18,882,000 to 18,700,000 tons.

Statistics of Electric Utilities

The sixth annual report " Statistics of Electric Utilities in the United States," published by the Federal Power Commission covers the year ended December 31st, 1942, and the operations of the 359 major privately owned utilities with assets aggregating $18,010 million. A five-year survey which is included for the first time shows that generating capacity has increased by 17 per cent. and sales of energy by 52 per cent. In spite of increased expenses net profits have substantially improved.

Overhead Lines

Method of Stress-Testing

By R. C. Golding,
M.Sc.(Eng.), A.M.I.E.E., A.M.I.Mech.E.
Deputy Borough Electrical Engineer, Great Yarmouth

WHILE arc-suppression coils in use in this country are commonly short-time rated and equipped with means of short-circuiting the coil, thus tripping out the feeder after a fault has endured for several seconds, an alternative line of thought is to regard them as a means of maintaining the supply under sustained, as well as transient, fault conditions. This has always been the policy of the Great Yarmouth Corporation, for instance, and as a result of the requirements of the system it has recently been found expedient to develop a means of using these coils for stressing the lines with a view to detecting incipient faults.

The Corporation's system includes approximately 125 miles of overhead line situated within fifteen miles of the East Coast, and subject to strong east winds in a salt-laden atmosphere.

The lines were originally insulated for 11 kV; subsequently part of the system was re-insulated for 16 kV. The system used to consist of four radial feeders emanating from one central point, each with its own 6·6/11-kV transformer and Petersen coil, but capable of being connected into two rings should this be desired. The coils were continuously rated and were not provided with short-circuiting arrangements.

In 1940, with a view to reducing no-load transformer losses, the four feeders were fed from a common 11-kV busbar supplied by one transformer, the star point being connected to the coils banked in parallel.

Effect of New Arrangement

The first result noticed was an increase in the number of flash-overs and broken insulators. It seemed obvious that whereas under the first arrangement a breakdown on one phase of a line raised the potential of the other two phases to earth on that line only, after paralleling the lines a fault on any line "stressed" the whole system, that is, any particular line experienced fault conditions four times as often, with a consequent increase in the flash-overs on otherwise sound phases, operating with insulator surfaces soiled with salt deposits.

It was therefore decided to raise the system insulation to 22 kV and at the same time to introduce an artificial system of stressing each line in turn at a convenient time for undertaking the repair of insulators breaking down under treatment. This was achieved by placing the line to be tested on to spare busbars, fed by a spare transformer and a spare Petersen coil, able to be tuned to suit any desired line. An earth was then applied to the switchgear busbars, thus raising the potential of the other two phases for as long as desired.

Constructional Features

The hospital busbars of the switchgear were tapped by means of an L-type trifurcating box and a cable was taken to a brick cubicle built as an extension to the switch house. This was desirable as an old oil circuit-breaker of only some 10 MVA breaking capacity was used for applying the earth. The use of this circuit-breaker appeared to be justified since it was to be used only in the form of a remote controlled isolator. By closing one or the other single-phase isolators and then closing the switch an earth could be placed on any desired phase. If a fault developed on a second phase while the test was proceeding the testing breaker would not operate since the tripping current transformers had been removed. The short-circuit current would therefore be broken by a 150-MVA oil circuit-breaker controlling the supply to the line without damage to personnel or apparatus. A second possibility was that the earthing breaker might be closed while a fault already existed on another phase of the line to be tested. This possibility was obviated as explained later.

The remaining possibility was that precisely at the moment when the earthing breaker was closed on to one phase an earth fault might develop on a second phase. In this event the contacts of the 10-MVA breaker would be subject to the rupturing force engendered by closing a switch on to a fault, and it was to safeguard personnel and property from this possibility that the earthing breaker was enclosed in a separate brick cubicle.

The breaker used was an old electrically operated reclosing type with lock-out facilities after a specified number of closures. A means of controlling the supply to the closing mechanism was provided in the

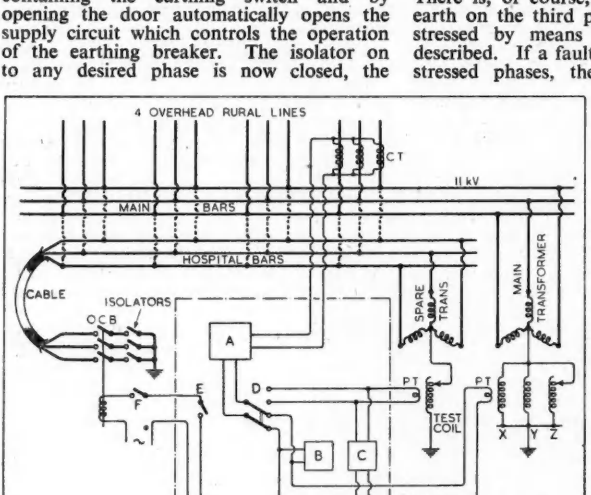
control room and the breaker arranged to lock-out after one operation. The lock-out facility was thus used as a means of ensuring that the breaker could not be operated from the control room while personnel were in the switch house.

Method of Operation

To place a line under test the spare transformer and hospital bars are energised and the line changed over to these busbars. The operator then enters the brick cubicle containing the earthing switch and by opening the door automatically opens the supply circuit which controls the operation of the earthing breaker. The isolator on to any desired phase is now closed, the operator resets the lock-out mechanism shown at F in the accompanying diagram which was automatically locked out after the last operation of the o.c.b. and then proceeds to the control room. Here the line-indicating relay, A, receiving spill-over operating current from current transformers in the line and operating voltage from the potential transformer of the banked arc-suppression coils, XYZ, has its voltage element changed over to the test-coil potential transformer by means of the switch D. A voltage-operated relay, C, indicates whether a fault exists on the line connected to the test coil.

The operator now prepares to close the switch, E, which will energise the o.c.b. and place an earth on the busbars. If, however, a fault already exists on the line to be tested, the relay, C, will indicate this and by means of contacts which are opened under fault conditions will prevent the closing of the o.c.b. If, however, the line is clear of faults then the o.c.b. can be closed, putting an earth on the line and energising C, which then indicates the condition existing. At the same time the o.c.b. locks out, thus preventing further closure until a visit has been paid to the switch house.

Experience to date shows that a convenient period during which time the line should remain stressed is two hours, after which the o.c.b. is then opened, the earth placed on a second phase and the process repeated. There is, of course, no reason to place an earth on the third phase, since all lines are stressed by means of the two operations described. If a fault develops on one of the stressed phases, then the line o.c.b. will open, thus cutting off the supply to the line. Since, however, the tests are carried out at a time when the minimum of inconvenience will be caused, this is considered preferable to allowing the fault to occur at a time which experience would seem to indicate is usually under weather conditions adverse to the speedy finding and repair of the fault. When the line o.c.b. opens, the busbar earth is removed, the line again made alive and left energised with the earth fault existing on one phase and thus isolated from the rest of the system until a favourable opportunity occurs to undertake the location and repair of the fault. The tests are usually carried out early on Sunday morning and repairs performed later that day when the switching for isolation purposes will cause the minimum of interruption.



Connections for stress-testing overhead lines

Meter Reading Tuition

A FUEL saving propaganda device has been arranged by Mr. Sim, meter superintendent, as a window display in the electricity showroom at Falkirk. "Can you read your meter?" is printed boldly on a window poster, on which there is an outline drawing of a hand with fingers stretched out. All the spectator has to do is simply to plant his, or her, own hand over the drawing, which action disturbs the capacity balance of a tuned condenser circuit. Thus a valve relay is caused to energise a miniature synchronous motor driving the counting train of a watt-hour meter above the poster. By causing the dial pointers to rotate at will in this way consumers may learn how to read their own meters with greater certainty.

Post-war Export Trade

Opportunities in South America

BETWEEN the official attitude of the United States towards post-war export trade and that of the United Kingdom there is a striking contrast. On this side it has been quite recently stated in Parliament that the Department of Overseas Trade is engaged in producing reports upon individual markets. They are being brought up to date periodically as and when information is received from overseas, but none has been issued. It has not been explained whether this reticence is due to a desire not to divert manufacturers and exporters from their war effort. However that may be, there seems at the same time to be an assumption on the part of the authorities that no advance study of the D.O.T.'s market reports is necessary, at any rate for the present.

On the other hand American manufacturers and exporters are being kept informed regarding prospects in export markets by a steady stream of information published in *Foreign Commerce*, the weekly organ of the United States Department of Commerce. A good example of the type of report which is made available is a recent well-balanced article on plans and prospects for the production and use of electricity in the various South American republics.

On account of the limited occurrence of commercial deposits of coal and the shortage of imported fuel arising from the war, many of the southern republics have been taking fresh stock of their water-power resources. At the same time the expansion of various industries has stimulated interest in long-range power programmes.

Brazil.—In Brazil, which has large unexploited sources of water power and has been experiencing a very great development of new industrial activities, there are plans to harness the great São Francisco River and to exploit the agricultural and mineral resources —iron, gold, mica, bauxite, quartz, diamonds, and copper—of this 260,000-sq. mile valley. Just below the city of Itaparica and 140 miles from the mouth of the river, a hydro-electric station is projected to develop 200,000 HP. The U.S. Technical Mission to Brazil has suggested a survey for the development of this river similar to the one carried out in the Tennessee Valley. It is stated that Brazil also plans to electrify more of its railways. On a 90-mile section of the Sorocabana Railway, connecting São Paulo with São Antonio, work has been started. The 80-ton locomotives now in use are to be replaced by 180-ton electric locomotives, ten from the United States.

Argentina.—Compared with Brazil's installed capacity of 993,742 kW (1940 figure), Argentina has only 700,000 kW, mostly in the populous industrial Atlantic seaboard area, several hundred miles away from the water-power sites in the foothills of the Andes. The republic has only 31,000 kW of hydro-electric power, nearly all of which is in the provinces of Mendoza, Cordoba, and Tucuman. As part of a national public-works programme, Argentina proposes to construct a number of irrigation projects in the north and west. Wherever possible this water also will be used to produce electric power, though this development is secondary to irrigation.

Uruguay.—Both Chile and Uruguay have programmes for the complete electrification of their public services, industries and railways. At Rio Negro the latter has a large water-power site in the middle of the country and only 150 miles from Montevideo. There a 30,400-kW water-wheel generator (of U.S. manufacture) will shortly be installed and a transmission line to the capital city is to be erected.

Uruguay has several more water-power and irrigation projects including a dam on the Quequay River, north of Paysandu, to develop 8,000 kW ; one on the Arroyo Cunapiru in the north of the republic to develop 10,000 kW, and to serve the cities of Rivera and Tacuarembo ; and a dam on the Cebollati River in the east to develop 11,000 kW and to serve Maldonado, Treinta y Tres and other communities.

Chile.—The Chilean Development Corporation cites the chief centres of potential hydro-electric energy as (1) the Aconcagua region to the north of Santiago ; (2) the Rancagua region along the Rapel River just to the south of the capital ; and (3) the Osorno region. The Aconcagua system will be used largely in cement production and will also contribute to the electrification of the railways. The Rapel plant is to have an initial capacity of from 60,000 to 120,000 kW, with a 34-mile transmission line connecting with the port of San Antonio. Part of the power will be used for railway electrification. The installation, plans for which are well advanced, will, it is said, be the largest of its type in the whole of South America.

On the River Laja the " Abanico " plant is now under construction with an immediate potential of 40,000 kW and a final capacity of 100,000 kW. A 100-mile transmission line connects with the city of Concepcion. The extraordinary economy achieved in the construction of the plant is stated to warrant this unusually long transmission line. Chile recently purchased a copper plant from the

United States with a capacity of 30,000 tons of finished copper a year. This will produce wire for the national electrification schemes.

Peru.—In Peru, at Cañon del Pato on the Santa River, Mr. Barton Jones, an electrical engineer who was previously associated with the Tennessee Valley Authority, has started work on a project which includes the installation of five generators of 25,000 kW each, the first two of which are to be ready by the end of 1945. Generating capacity for Lima is to be increased to 91,000 kW by a new dam.

The foregoing are some of the leading South American electrical projects to which the official organ of the U.S. Department of Commerce draws the attention of electrical engineering concerns. It points out at the same time that a number of the countries have indicated their desire to have their electric power facilities controlled by their own nationals. They desire foreign equipment and foreign technical assistance more than foreign capital. However, there should be an opportunity for engineers and manufacturers in the United States to participate on a mutually advantageous basis.

ELECTRICITY SUPPLY

Cable-Laying by Plough. Southend Deficit.

Ayrshire.—IMPROVING THE SUPPLY.—Underground cables are being laid to relieve the strain on existing lines in Ayrshire. The company employed on the contract is Clough, Smith & Co., Ltd., London, and the resident engineer is Mr. J. Munro, who returned to Ayrshire, after twenty years in England, to supervise the work. Drastic cuts in time and labour are achieved by the use of two 100-HP Diesel windlasses pulling a three-ton plough, on which are fixed 220-yd. lengths of cable, each weighing another three tons. The plough cuts a furrow approximately 3 ft. deep, and the cable is fed in at an average rate of over 200 yd. a day. The trench is self-sealing. The company has already laid over 200 miles of cable by this method in England, including 7,000 yd. in four weeks and 5,000 yd. in eighteen days. In Ayrshire seven men and a machine are doing the work of about 50 men and in half the time.

Bedlington (Northumberland).—OPPOSITION TO OVERHEAD LINES.—The Urban Council is opposing the erection of overhead lines by the North-Eastern Electric Supply Co., Ltd.

Birkenhead. — PUBLIC LIGHTING. — At a meeting of the Watch Committee the Chief Constable reported that the borough electrical engineer had informed him that the electric lighting of the borough could be reinstated within one week of the war ending. On the question of the use of searchlights, which had been suggested at a meeting, a Government Department had reviewed this form of street lighting and did not consider that it would be satisfactory.

Clydebank.—ELECTRODE BOILERS.—The Town Council after a lengthy discussion on the heating system to be installed in the Municipal Buildings and Baths, has decided on electrode boilers to replace the present coal-fed boilers.

Falkirk.—MODIFIED LIGHTING.—The burgh electrical engineer has been authorised to complete a modified street lighting scheme in the centre of the town. An order has been given for the delivery in six weeks of 108 lamps.

Ilford.—SUPPLY TO SCHOOL.—The Electricity Committee is to provide an electricity supply to a temporary school at Barkingside at a cost of £3,500, which includes provision for a sub-station.

Morecambe.—OVERHAULING ILLUMINATIONS.—The Illuminations Sub-Committee has approved an expenditure of £250 on reconditioning the illumination materials. In the next Corporation Bill power is to be sought for the provision of additional public illuminations.

Pontefract.—EXTENSION OF TIME.—The Electricity Commissioners have made an Order extending for three years the period ended April 2nd, 1943, within six months after the expiration of which the Corporation may re-acquire the undertaking.

Renfrewshire. — POLICE STATION INSTALLATION.—The County Property Committee has approved a recommendation by the chief constable to install electricity at Thornliebank police station at a cost of £80 including £20 for a cooker.

Southend.—LOSS ON ELECTRICITY UNDERTAKING.—It was reported by Councillor D. G. Verney, chairman of the Electricity Committee, at a meeting of the Town Council on December 21st, that during the past year there had been a loss of £58,000 on the electricity undertaking, and that since the outbreak of war the reserve fund and working balance of £155,000 had been exhausted.

Councillor Verney was moving the adoption of the 1942-43 annual report of the borough electrical engineer (Mr. A. C. Johnson) which, he said, afforded a striking vindication of the pre-war policy of the Committee and the chief officers. At the outbreak of war the undertaking was in a very sound position. Two major schemes had been carried through. Firstly, at considerable cost an AC supply had been substituted for the DC system except in the actual centre of the town. This work, together with general development, involved the laying of over 350 miles of cable. Even in the central shopping area the new cable had been laid and was available when required. Secondly, they embarked upon a large and in many respects novel domestic electrification including the supply to consumers of cookers, water heaters, etc., upon terms which, while economically sound, were within the reach of all. The result exceeded all expectations and enabled the tariffs to be substantially reduced. The position was adversely affected some eight years ago when at the quinquennial valuation the assessment of the undertaking was increased by

£22,000, or nearly 75 per cent. This arose mainly from the fact that the valuation coincided with a substantial profit on the undertaking before it had been possible to distribute it to the consumers by means of reduced tariffs. That position has not recurred and the undertaking had long since become entitled to a considerable reduction in the assessment, as had in fact recently taken place in respect of the gas undertaking. Nevertheless at the outbreak of war the Electricity Department had a reserve fund and an unappropriated working balance totalling £155,000. War conditions had resulted in the complete exhaustion of that sum and had created a serious annual loss.

The chairman pointed out that the approximate loss for the year ended March last, amounting to £58,000, included a payment of rates of approximately £35,000, representing nearly a farthing per kWh sold; the actual annual loss was not being carried forward as an outstanding liability but was being met out of the general rate fund, which had the assistance of the Government grant. He added that the Committee was concerned at the loss of the undertaking's valuable reserve fund and working balance and at the opportune moment every possible pressure would be brought to bear on the Government to replace at least a substantial portion of that loss.

In conclusion, Councillor Verney said that he felt justified in viewing the position of the undertaking with sober confidence in the knowledge that it was capable of fully satisfying all reasonable demands of the post-war years.

Wigan.—MAINS EXTENSIONS.—The Lancashire Electric Power Co. is to extend mains for supply to Beechwood Colliery, Harrock Hill.

Overseas

Bulgaria.—ECONOMY MEASURE.—It is announced that all factories and workshops must switch off their electric motors after 5 p.m. Already 285 shops, 75 workshops and 89 houses have had their supply cut off altogether for non-compliance with orders.

Spain.—SEVILLE POWER SCHEME.—The German official news agency reports that the Compania Sevillana de Electricidad is to build a new power plant near Tablada next year. The initial capacity will be 30,000-40,000 kW.—*Reuter's Trade Service.*

Victoria.—COMMISSION'S REPORT.—The *Industrial Australian and Mining Standard* reports that a net profit of £844,207 was made by the Victorian State Electricity Commission for the year 1942-43, which, after deduction of appropriations, left a surplus of £141,393. After applying a portion of the surplus to extinguish earlier losses, there remained a balance of £4,855 on the profit and loss account at June 30th. Profit from electricity supply was £1,241,343 and on brown coal, £7,296, while there were losses of £10,581 on briquetting and £14,008 on the Ballarat, Bendigo and Geelong tramways.

According to the Auditor-General, Mr. E. A. Peverill, briquettes produced totalled 414,959 tons, compared with the peak production figure of 433,756 tons in 1940-41. The accumulated loss on briquette manufacture was £306,849. The large-scale production of briquettes has been a factor in stabilising the price of other fuels, in addition to increasing the amount available.

TRANSPORT

France.—ELECTRIFICATION COMPLETED. — Radio Paris announces that the State Railway line from Paris to Port-Bou has now been electrified.

Newcastle-on-Tyne.—TROLLEY-BUSES OVER THE TYNE.—It was reported to the Felling Urban District Council that a meeting had been held between the Newcastle, Gateshead and Felling local authorities and the Gateshead and District Tramways Co. regarding the plan to run trolley-buses over the Tyne bridges into Gateshead from Newcastle. The tramways company suggested that there were too many low bridges in Gateshead for running double-deck trolley-buses, and single-deckers would not be suitable. The company proposed that a "standstill agreement" should be applied to the subject for three years.

The local authorities opposed the suggestion and agreed that immediate preliminary steps should be taken to obtain powers to operate trolley-buses when circumstances allowed. Individual consideration would be given to routes which were stated to be unsuitable for trolley vehicles. It was stated that there were no obstacles to the running of trolley-buses through Gateshead to Heworth, in the Felling Council's area.

Portugal. — ELECTRIFYING THE "TOURIST TRIANGLE."—A commission has been set up to prepare plans for electrifying the railway from Lisbon to the mountain resort of Cintra and the building of a new line from Cintra to the fishing harbour of Cascais. This would complete the electrification of the famous "Tourist Triangle."—*Reuter.*

Southend-on-Sea. — ADDITIONAL TROLLEY-BUSES.—The Ministry of Transport has intimated that it is prepared to allocate three Sunbeam four-wheel trolley vehicle chassis to the Corporation at a cost of £1,636 each. The Corporation has decided to accept the chassis at the price named.

RADIO & TELEPHONY

Portugal.—EQUIPMENT FROM AMERICA.—Senor Manuel Buvar, technical director of Portuguese State Broadcasting, who has just returned from the United States, secured special supply facilities during his visit. It is learned that materials for re-equipping and increasing the power of Portuguese radio stations will now be available in increasing quantities.—*Reuter.*

Tide and Speed Tables

We have received from Marine Instruments, Ltd. (an association of Kelvin, Bottomley & Baird, Ltd., and Henry Hughes & Sons, Ltd.) a pocket book containing a good deal of information of service to mariners, including tide tables, particulars of docks, speed tables, weather data, etc.

A.S.E.E. Annual Meeting

The Association of Supervising Electrical Engineers is holding its annual general meeting in London on Saturday, May 20th, at 2 p.m.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

E. K. Cole, Ltd.—Speaking at the annual meeting on December 31st the chairman and joint managing director (Mr. W. S. Verrells) said that the output from the company's factories had been the highest on record. While their manufacturing interests had expanded, they had remained within the basic field of their pre-war production. By their acquisition of control of Ensign Lamps, Ltd., they had attained an important position in the electric lamp industry. The investments reserve, which stood at £40,000 in the 1942 balance sheet, had not been wholly absorbed by the loss on the realisation of their holding in Scophony, Ltd., and the balance had been deducted from the cost of acquiring the holding in Ensign Lamps, Ltd.

The company was now interested in broadcast radio reception, communication and signalling equipment, television, electric lamps and fittings, plastics, convection heating and air-conditioning apparatus, household domestic appliances and electronic scientific instruments. The proposed increase of £250,000 in the ordinary capital was only anticipatory of future requirements; there would be no immediate issue but when an issue was made shareholders would be given preferential consideration.

After the adoption of the report and accounts resolutions were passed raising the ordinary capital to £900,000 by the creation of 1,000,000 ordinary shares of 5s. each and converting the issued preferred, preferred ordinary and ordinary shares into corresponding stock.

Ensign Lamps, Ltd.—At the annual meeting on December 31st, the chairman and managing director (Mr. W. V. Green) said that the measure of concentration in the lamp industry had resulted in the transfer of many of the company's key workers to employment elsewhere. As a consequence they had to arrange for the greater part of their output to be catered for from the permitted capacity of other lamp makers. Referring to the acquisition of a controlling interest in the company by E. K. Cole, Ltd., Mr. Green said that they had no doubt that this would be in the best interests of the company.

The demand for their products had been well maintained. The reconstituted board had decided to pursue a policy of strengthening the reserve position to ensure the company's financial stability and provide for research and development.

The General Cable Manufacturing Co., Ltd.—Speaking at the ordinary general meeting on Thursday last week Mr. C. W. R. Pantlin (chairman) said that throughout the year production was well maintained in all departments and plant fully employed. Practically the entire output, however, was again taken for war purposes, leaving little available for ordinary business. Including the appropriate tax deductions from dividends it would be found that the Government was taking, by way of taxation, approximately 85 per cent. of the total profit earned. The balance of 15 per cent. which the company was allowed to retain provided dividends to shareholders and allowed only £5,000 to be placed to reserve.

S. Smith & Sons (Motor Accessories), Ltd., held its ordinary general meeting on December 30th. Mr. W. Henderson-Cleland (chairman) stated that, as far as was possible without affecting war production in any way, the directors were making plans for the utilisation of the company's large facilities for the production of peacetime equipment to come into effect immediately hostilities ceased.

British Industrial Plastics, Ltd., report gross profits for the year ended September 30th totalling £327,852, which compares with £295,799 in 1941-42. After providing for general and special expenses, depreciation, £14,426 (£27,341) and taxation £199,500 (£155,500) there is a net profit of £21,659 (£21,424). The ordinary dividend is maintained at 8 per cent. and £8,168 (£6,698) is carried forward.

Tecalemit, Ltd., reports a net profit for the year ended July 31st last (after providing for taxation) of £91,055, an increase of £27,652 as compared with the previous year. After paying a final dividend of 12 per cent., making 18 per cent. (same) for the year, £29,634 is carried forward.

The Nigerian Electric Supply Corporation, Ltd., is to redeem £66,778 6 per cent. first mortgage redeemable debenture stock at 101 on June 30th next. The stock to be repaid will be determined by a drawing to be made on or about June 5th. At the same time £12,850 of the stock will be drawn for repayment at par.

Sydney S. Bird & Sons, Ltd.—A statement by the managing director, Mr. Sydney S. Bird, presented at the annual general meeting last week, pointed out that as profits were limited by E.P.T. to rather more than £20,000 per annum subject to income tax, there was little or no indication in the accounts of the exceedingly busy year they had had.

David Brown & Sons (Huddersfield), Ltd., report a trading profit (after meeting depreciation and E.P.T.) of £207,945 for 1942-43, against £187,135 for the preceding year. An excess dividend of 2½ per cent. is again being paid on the participating preference shares and the ordinary dividend is maintained at 10 per cent.

New Companies

Tele-Radio (1943), Ltd.—Private company. Registered December 23rd. Capital, £500. Objects: To acquire the business carried on by Robert B. Barnett, as the Rapid Radio Repair Service, at 177a, Edgware Road, W.2, and to carry on the business of wireless and electrical engineers and dealers, etc. R. B. Barnett, 1, Norfolk Mews, Hyde Park, W.2, is the first director. Registered office: 177a, Edgware Road, W.2.

J. W. Squire, Ltd.—Private company. Registered December 22nd. Capital, £3,000. Objects:

CONTROL

Oil Immersed Rotor and Stator Starter

Up to 50 H.P., 400/440 VOLTS

VERITYS LTD.

ASTON, BIRMINGHAM 6

Sales Headquarters:
BRETTENHAM HOUSE, LANCASTER PLACE, W.C.2

MARTINDALE

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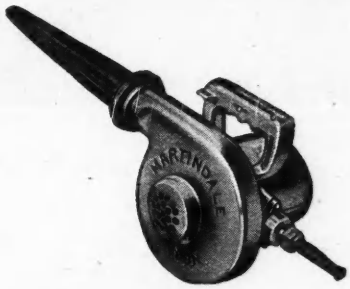

● The most efficient lightweight portable blowers ever put on the market. Precision-built on interchangeable lines, carefully balanced to eliminate vibration. Armatures and coils impregnated to withstand all conditions of service all over the world

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Westmorland Road, London, N.W.9
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THREE MODELS:

1. "MILL TYPE" 2. "STANDARD" 3. "BLOW-ER CLEAN"

● All models can be instantly converted into powerful industrial vacuum cleaners

We can control the speed of an engine within
0·3
per cent

Iso-Speedic

The Iso-Speedic Company Ltd., Coventry. Telephone: Coventry 3147
Telegrams: Isospeedic, Coventry

To acquire the business of an electrical contractor, radio engineer, etc., carried on by J. W. Squire at 157, Humberstone Road, Leicester. Directors: J. W. Squire, 38, Byway Road, Leicester and R. H. Roberts, 62, Greenhill Road, Leicester. Registered office: 157, Humberstone Road, Leicester.

Malcolm Battery & Engineering, Ltd.—Private company. Registered December 21st. Capital, £1,000. Objects: To carry on the business of electrical, mechanical, motor and general engineers, manufacturers of, and dealers in, batteries, tools and wireless goods, etc. Directors: R. H. Dickinson and Mrs. H. E. G. Dickinson, both of 7, Ashtree Avenue, Tile Hill Lane, Coventry. Registered office: 62, Radford Road, Coventry.

Benn Radio & Electrical Co., Ltd.—Private company. Registered December 21st. Capital, £1,500. Objects: To acquire the business of radio and electrical engineers carried on by S. S. Fishlock and R. C. Fishlock, as Benn Radio & Electrical Service, at 122, Hillmorton Road, Rugby. Directors: S. S. Fishlock and R. C. Fishlock. Registered office: 122, Hillmorton Road, Rugby.

Burleigh Electrics (London), Ltd.—Private company. Registered December 21st. Capital, £100. Objects: To carry on the business of electrical, cycle, motor and general engineers, etc. Directors: W. E. Eglinton, 5, Balfour Road, London, S.W.19 (permanent managing director) and B. Worth, 13, Montague Road, S.W.19. Solicitors: Corsellis & Berney, 94, East Hill, S.W.18.

Companies' Returns

Statements of Capital

Folkestone Electricity Supply Co., Ltd.—Capital, £237,500 in £1 shares (50,000 5 per cent. cumulative preference, 175,000 ordinary and 12,500 employees' co-partnership). Return dated March 20th (filed August 20th). All shares taken up. £200,000 paid. £37,500 considered as paid. Mortgages and charges: Nil.

Cawnpore Electric Supply Corporation, Ltd.—Capital, £547,986 in £1 shares (200,000 preference and 347,986 ordinary). Return dated September 16th. 200,000 preference and 318,500 ordinary shares taken up. £443,500 paid. £75,000 considered as paid. Mortgages and charges: £244,900.

Rawlings Brothers, Ltd.—Capital, £100,000 in £1 shares (70,000 ordinary and 30,000 preference). Return dated September 23rd, 1943. 61,401 ordinary and 21,903 preference shares taken up. £83,304 paid. Mortgages and charges : Nil.

Kye Electrical, Ltd—Capital, £25,000 in 20,000 preference shares of £1 each and 100,000 ordinary shares of 1s. each. Return dated, October 8th, 1943. 12,502 preference and 92,500 ordinary shares taken up, £17,127 paid. Mortgages and charges : Nil.

Concordia Electric Wire Co., Ltd.—Capital, £100,000 in £1 shares. Return dated August 11th (filed September 14th). 57,319 shares taken up. £57,319 paid. Mortgages and charges: Nil.

Electric Furnace Co., Ltd.—Capital, £200,000 in £1 shares (100,000 ordinary and 100,000 preference). Return dated, September 29th, 1943. 78,250 ordinary and 85,500 preference shares taken up. £19,750 paid. £144,000 considered as paid. Mortgages and charges: Nil.

Arrow Electric Switches, Ltd.—Capital, £5,000 in £1 shares. Return dated September 30th, 1943. 4,000 shares taken up. £4,000 paid. Mortgages and charges : Nil.

St. Helens Cable & Rubber Co., Ltd.—Capital, £100,000 in £1 shares. Return dated September 20th, 1943. 84,000 shares taken up. £84,000 paid. Mortgages and charges : Nil.

Increases of Capital

O'Connor Electrical Industries, Ltd.—The nominal capital has been increased by the addition of £1,150 in £1 ordinary shares beyond the registered capital of £1,350.

R. J. Kemp & Co., Ltd.—The nominal capital has been increased by the addition of £5,000 in £1 shares beyond the registered capital of £5,000.

Mortgages and Charges

R. J. Kemp & Co., Ltd.—Assignment on November 25th of proceeds of contract, to secure all moneys due or to become due from the company to Lloyds Bank, Ltd., not exceeding £2,000 at any one time.

Nevelin Electric Co., Ltd.—Satisfaction in full on August 30th, 1943, of debentures authorised August 29th, 1941, and registered September 29th, 1941, securing £4,400. (Notice filed December 21st, 1943.)

Bankruptcies

R. T. H. Brimfield (" Richfield Electrical Components "), electrical contractor, 73 and 78, High Holborn, London, W.C.1.—Order made October 12th, 1943, suspending bankrupt's discharge for three years from December 15th, 1942, subject to his paying £240 per annum or one half of his yearly income after deduction of income tax, whichever sum is the greater in any year, to the Official Receiver for distribution among the creditors until they have received 6s. 8d. in the £. First payment November 23rd, 1943.

C. G. Merrison, radio dealer, 61b, Raleigh Street, Walsall, Staffs.—This debtor was granted his discharge from bankruptcy, subject to the payment of £30, when he applied at the Court House, Lichfield Street, Walsall, recently. The Official Receiver stated that the debtor was adjudicated bankrupt on his own petition in August, 1938. The liabilities amounted to £798, whilst the assets realised £182. A first and final dividend of 2s. 3¾d. in the £ had been paid to the creditors.

C. J. Baldwin, electrical fitter, 212, Barton Road, Stretford, Lancs. Receiving order made December 22nd, 1943, on debtor's own petition. First meeting January 11th, at the Official Receiver's office, 20, Byrom Street, Manchester, 3. Public examination to be held on January 19th, at the Court House, Encombe Place, Salford. 3

STOCKS AND SHARES

TUESDAY EVENING.

PRICES of Stock Exchange securities during the year just finished have undergone rather less violent alterations than they do as a rule. For this the principal reason is the adherence of the Government to its policy of cheap money. This has had the effect of forcing up prices, particularly in the industrial market, to levels which are frequently condemned as being unduly high but which, as time goes on, confound the prophets by gaining still further improvement. So much has this been the case that, throughout the greater part of the year, Stock Exchange prices would seem to have pursued a one-way street. The changes are, in the majority of cases, by no means spectacular, but the strength of markets as a whole, throughout the twelvemonth, has been demonstrated by the steadiness with which quotations have held their ground.

Overseas Electricity

Comparative lists of shares in the Home electricity supply companies were given here last week, and it remains only to add a few examples of shares in overseas companies in order to complete a representative selection in this group. Two features are the rises in Victoria Falls ordinary and Palestine Electric, the advance in the latter being due to checks upon the enemy in the Middle East. Victoria Falls are now a standard investment stock. For Tokyo 6 per cents. to have gone back is not surprising, having regard to the recent successes of the Allies in the Pacific :—

Stock or Share	*December 31st,* 1942	1943	*Rise or Fall*
	s. d.	s. d.	s. d.
Calcutta	31 6	35 0	+3 6
Palestine	31 6	40 3	+8 9
Victoria Falls.. ..	78 9	86 3	+7 6
Whitehall pref. ..	20 0	24 0	+4 0
Tokyo 6 per cent. ..	21½	19	−2½

Dollar Stocks

The outstanding change in the list of cable stocks is the doubling of the price of International Telephone and Telegraph shares, these having come up from 7 to the present price of 14. During the twelvemonth, the price has been as high as 20, persistent American buying having absorbed the comparatively small number of shares that were available on this side. The shares are amongst those which can only be sold in the London market, purchases being possible only under exceptional circumstances. There are still a fair number of securities to which this regulation applies, most of them being dollar stocks. Brazilian Tractions are amongst the few in which there is permitted a free market, and in their case the present price of 26⅜ goes against 22¼ at which the price stood twelve months ago. A certain amount of investment business has taken place in Cable and Wireless ordinary and preference stocks, the latter showing a rise of 5½ points on the year. Our table shows these variations :—

Stock or Share	*December 31st,* 1942	1943	*Rise or Fall*
Anglo-American pf...	109¼	114¼	+5
Cable & Wireless pf...	107½	113	+5½
Cable & Wireless ord.	75½	77½	+2
Great Northern ..	23	22½	−½
International Tel. & Tel.	7	14	+7
Marconi Marine ..	31s. 6d.	32s. 3d.	+9d.

Manufacturing and Equipment

The most interesting market amongst those with which these pages deal from week to week has been that for shares in the manufacturing and equipment companies. Some few weeks ago, prices reached a level higher than any touched previously since the outbreak of war. Money was being invested in the ordinary shares of these companies with a persistence which raised the quotations until the average yield amounted to little more than 4 per cent. on the money. Post-war prospects was the popular slogan, nor was this confined to the best-class ordinary shares. It became applied to the shares of companies dealing with the radio branches, with special reference to those which add television to their activities. An animated market sprang up in radio descriptions. Prices of shares were advanced in a manner which seemed to be extravagant in view of the present paid dividends; speculation took a hand, and what with this, and talk of amalgamations, working agreements and so forth, the market assumed an appearance of strength, of which the greater part was retained until the end of the year. De la Rue shares, largely upon plastic possibilities, have risen from 87s. 6d. to £8.

The following list sets out details of the net movements that have occurred during the year in shares of some of the best-known companies in the manufacturing and equipment branches :—

Ordinary Shares	*December 31st* 1942	1943	*Rise*
	s. d.	s. d.	s. d.
Assoc. Elec. Ind. ..	48 0	49 0	1 0
British Insulated ..	100 0	107 6	7 6
Callender's	75 6	99 0	23 6
Crompton Parkinson (5s.)	24 0	27 0	3 0
English Electric ..	45 0	47 6	2 6
Ever Ready (5s.) ..	35 6	38 6	3 0
General Electric ..	86 0	88 6	2 6
Henley's (5s.).. ..	23 6	25 0	1 6
Johnson & Phillips ..	63 0	66 6	3 6

Dividend Expansion

By way of complement to the foregoing group, the prices of shares in twelve more companies connected with the industry may be usefully added. It will be noticed that the changes are in favour of previous share-

(*Continued on page* 34)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend Previous	Dividend Last	Middle Price Jan. 4	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies					
Bournemouth and Poole	12½	12½	61/6	..	4 2 0
British Power and Light	6	7	32/6	..	4 6 2
City of London	7	7	28/–	..	5 0 0
Clyde Valley	8	8	41/–	..	3 18 0
County of London	8	8	41/–	..	3 18 0
Edmundsons:					
7% Pref.	7	7	34/–xd	+6d.	4 2 4
Ord.	6	6	28/6	..	3 4 3
Elec.Dis.Yorkshire	9	9	44/–	..	4 1 10
Elec. Fin. and Securities	12½	12½	53/6	..	4 13 4
Elec. Supply Corporation	10	10	46/–	..	4 7 0
Isle of Thanet	Nil	Nil	18/–	..	—
Lancs. Light and Power	7½	7½	34/6	..	4 7 0
Llanelly Elec.	5½	6	25/–	..	4 16 0
Lond.Assoc.Electric	4	3	23/–	..	2 12 4
London Electric	6	6	27/6	..	4 7 3
LondonPowerRed. Deb.	5	5	103½	..	4 16 7
Metropolitan E.S.	8	8	41/6	+6d.	3 17 0
Midland Counties	8	8	39/–	..	4 2 1
Mid. Elec. Power	9	9	42/6	..	4 4 9
Newcastle Elec.	7	7	31/–	..	4 10 5
North Eastern Elec.:					
Ordinary	7	7	32/6	..	4 6 2
7% Pref.	7	7	34/6	..	4 1 2
Northampton	10	10	48/–	..	4 3 4
Notting Hill 6% Pref. (£10)	6	Nil	10	..	—
Northmet Power:					
Ordinary	7	7	37/6	..	3 14 8
6% Pref.	6	6	30/–	..	4 0 0
Richmond Elec.	6	6	26/–	..	4 12 4
Scottish Power	8	8	39/6	+1/–	4 1 0
Southern Areas	5	5	22/6	..	4 9 0
South London	7	7	27/–	..	5 3 8
West Devon	5	5	23/6	..	4 5 0
West Glos.	4½	3½	24/–	..	2 18 4
Yorkshire Elec.	8	8	42/6	..	3 15 3
Overseas Electricity Companies					
Atlas Elec.	Nil	Nil	6/9	..	—
Calcutta Elec.	7*	6*	35/–	..	3 8 8
Cawnpore Elec.	10	10	35/–	..	5 14 3
East African Power	7	7	33/–	..	4 4 10
Jerusalem Elec.	7	5	28/–	..	3 11 5
Kalgoorlie (10/–)	5	5	10/–	..	5 0 0
Madras Elec.	4*	Nil	23/–	..	—
Montreal Power.	1½	1½	21	..	6 19 6
PalestineElec."A"	4*	5*	40/3	..	2 9 10
Perak Hydro-elec.	6	7	10/–	..	—
Shawinigan Power	83cts.	90cts.	16	−½	—
Tokyo Elec. 6%	6	6	19	..	—
VictoriaFallsPower	15	15	4½xd	+6d.	3 9 7
Whitehall Inv.Pref.	—	—	24/–	..	4 3 4

Company	Dividend Previous	Dividend Last	Middle Price Jan. 4	Rise or Fall	Yield p.c. £ s. d.
Public Boards					
Central Electricity:					
1955–60 (Civil Defence)	—	3	100	..	3 0 0
1955–75	5	5	115	+1	4 7 0
1951–73	4½	4½	106	..	4 4 1
1963–93	3½	3½	102½	..	3 8 4
1974–94	3¼	3¼	99	..	3 5 8
LondonElec.Trans. Ltd.	2½	2½	97	..	2 11 3
London & Home Counties1955–75	4½	4½	111	..	4 1 1
Lond.Pass.Trans.:					
A	4½	4½	118½	+1	3 16 0
B	5	5	118½	..	4 4 5
C	2⅞	3	65	..	4 12 4
WestMidlandsJ.E.A. 1948–68	5	5	109	..	4 11 9
Telegraph and Telephone					
Anglo-Am. Tel.:					
Pref.	6	6	114½	−½	5 4 10
Def.	1½	1½	28	..	5 7 1
Anglo-Portuguese	8	8	24/–	..	6 13 4
Cable & Wireless:					
5½ Pref.	5½	5½	113	..	4 17 4
Ord.	4	4	77½	+½	5 3 3
CanadianMarconi$1	Nil	4cts.	8/–	..	—
Globe Tel. & Tel.:					
Ord.	8½*	5*	37/–	..	2 14 0
Pref.	6	6	29/3	..	4 2 1
Great NorthernTel. (£10)	Nil	Nil	22½	..	—
Inter. Tel. & Tel.	Nil	Nil	14	−½	—
Marconi-Marine.	7½	7½	32/3	..	4 13 0
Oriental Tel. Ord.	16	10	44/–	+6d.	—
Telephone Props.	6	Nil	17/6	..	—
Tele.Rentals(5/–)	10	10	11/6xd	..	4 7 0
Traction and Transport					
Anglo-Arg.Trans.:					
First Pref. (£5)	Nil	Nil	3/–	..	—
4% Inc.	Nil	Nil	8½	..	—
Brit.Elec.Traction:					
Def. Ord.	45	45	1045	..	4 6 4
Pref. Ord.	8	8	175	..	4 11 5
Bristol Trams	10	10	52/–	..	3 17 0
Brazil Traction	$1	$1½	26⅛	..	6 11 6
Calcutta Trams.	5½	6½	36/–	+6d.	3 13 5
Cape Elec. Trams	5	6	24/–	..	5 0 0
Lancs. Transport	10	10	44/3	..	4 10 4
Mexican Light:					
1st Bonds	5	5	103½	..	4 16 7
Rio 5% Bonds	5	5	106½	..	4 14 0
Southern Rly.:					
5% Prefd.	5	5	76	..	6 11 7
5% Pref.	5	5	116	..	4 6 2
T. Tilling	10	10	54/6	..	3 13 3
West Riding	10	10	44/–	..	4 11 0

(*Continued on next page*)

* Dividends are paid free of Income Tax.

Company	Dividend Previous	Dividend Last	Middle Price Jan. 4	Rise or Fall	Yield p.c.
Equipment and Manufacturing					
			£ s. d.		
Aron. Elec. Ord. .	10	15	55/–	..	5 9 1
Assoc. Elec. :					
Ord.	10	10	49/–	..	4 1 8
Pref.	8	8	38/6	..	4 3 1
AutomaticTel.&Tel.	12½	12½	56/3	..	4 10 0
Babcock & Wilcox	11	11	48/6	+1/–	4 10 9
British Aluminium	10	10	47/6	+6d.	4 4 0
British Insul. Ord.	20	20	5¾	..	3 14 4
British Thermostat (5/–)	18½	18½	19/–	..	4 17 4
BritishVac.Cleaner (5/–)	15	30	27/–	..	5 11 1
Brush Ord. (5/–)	6	8	8/6	..	4 14 2
Burco (5/–) ..	15	17½	15/3	−3d.	5 14 9
Callender's ..	15	20	99/–	+1/–	4 1 0
ChlorideElec.Storage	15	15	80/–	..	3 15 0
Cole, E. K. (5/–)	10	15	25/6	..	2 18 10
Consolidated Signal	17	24	5½	..	4 5 1
Cossor, A. C. (5/–)	7½*	10*	22/6	..	2 5 6
Crabtree (10/–) ..	17½	17½	36/3	..	4 16 7
CromptonParkinson Ord. (5/–) ..	20	22½	27/–	..	4 3 4
E.M.I. (10/–) ..	6	8	27/9	+6d.	2 17 9
Elec.Construction	10	12½	50/6	..	4 19 0
Enfield Cable Ord.	12½	12½	59/ –	−6d.	4 4 8
English Electric. .	10	10	47/6	+6d.	4 4 0
EnsignLamps(5/–)	25	15	20/–	..	3 15 0
Ericsson Tel. (5/–)	22*	20*	51/3	..	1 19 0
Ever Ready (5/–)	40	40	38/6	..	5 4 0
Falk Stadelmann	7½	7½	32/–	..	4 13 9
Ferranti Pref. ..	7	7	29/6	..	4 15 0
G.E.C. : Pref.	6½	6½	32/–	..	4 1 3
Ord.	17½	17½	88/6	..	3 19 2
Greenwood&Batley	15	15	41/3	..	7 5 9
HallTelephone(10/–)	12½	12½	25/6	+6d.	4 18 1
Henley's (5/–) ..	20	20	25/–	..	4 0 0
4½% Pref. ..	4½	4½	23/–	..	3 18 3
Hopkinsons ..	15	17½	60/–	..	5 16 8
India Rubber Pref.	5½	5½	21/6	..	5 2 4
Intl. Combustion	30	30	6½	..	4 16 0
Johnson & Phillips	15	15	66/6	..	4 10 3
LancashireDynamo	20	22½	92/–	..	4 18 6
Laurence,Scott(5/–)	12½	12½	13/–	..	4 16 2
London Elec. Wire	7½	7½	33/6	..	4 9 7
Mather & Platt ..	10	10	52/–	..	3 18 9
Metal Industries(B)	5	8	44/3	..	3 12 2
Met.Elec.CablePref.	5½	5½	21/3	..	5 3 6
Murex	20	20	100/–	..	4 0 0
Pye Deferred (5/–)	25	25	26/3	..	4 15 3
Revo (10/–) ..	17½	17½	38/9	..	4 10 6
Reyrolle ..	12½	12½	70/–	..	3 11 5
Siemens Ord. ..	7½	7½	33/6	..	4 9 7
Strand Elec. (5/–)	7½	10	7/9	..	6 9 0
Switchgear&Cowans (5/–)	10	20	18/–	..	5 11 1
T.C.C. (10/–) ..	5	5	18/9	..	2 13 4
T.C. & M. ..	10	10	49/6	+1/–	4 1 0
TelephoneMfg.(5/–)	9	9	11/–	..	4 1 10
Thorn Elec. (5/–)	20	20	22/–	+3d.	4 11 0
Tube Investments	20	20	91/6	+6d.	4 7 4
Vactric (5/–) ..	Nil	Nil	14/6	..	—
Veritys (5/–) ..	7½	7½	7/3	..	5 3 5
Vickers (10/–) ..	10	10	17/6	..	5 14 3
WalsallConduits(4/–)	55	55	45/–	..	4 17 9
Ward & Goldstone (5/–)	20	20	27/3	..	3 13 5
WestinghouseBrake	10	12½	65/–	..	3 17 0
West, Allen (5/–)	7½	7½	6/9	..	5 11 2

* Dividends are paid free of Income Tax.

Stocks and Shares (*Continued from page* 32)

holders, an eminently satisfactory showing at the end of the year, though less pleasing to prospective purchasers who want to take an interest in these shares or, having already a holding, desire to increase it. Dividends have expanded in various cases, *e.g.*, in

Ordinary Shares	December 31st, 1942 s. d.	1943 s. d.	*Rise* s. d.
Automatic Tel. & Tel.	53 0	56 3	3 3
Crabtree (10s.) ..	36 0	36 3	3
Elec. & Musical (10s.)	19 9	27 9	8 0
Elec. Construction ..	39 0	50 6	11 6
Enfield Cable ord. ..	58 6	59 0	6
Ericsson Tel. (5s.) ..	43 9	51 3	7 6
Lancs. Dynamo ..	76 6	92 0	15 6
Mather & Platt ..	46 3	52 0	5 9
Reyrolle	62 0	70 0	8 0
Siemens	28 0	33 6	5 6
Telegraph Construction	46 0	49 6	3 6
Westinghouse Brake ..	57 6	65 0	7 6

Callender's, Burco, British Vacuum Cleaner, Crompton Parkinson, Brush, Switchgear & Cowans, Lancashire Dynamo, Hopkinsons, Electric Construction, and Arons. The Consolidated Signals dividend rose from 17 to 24 per cent.; Westinghouse Brake from 10 to 12½ per cent.; Metal Industries from 5 to 8 per cent. These have emphasised the previous strength of the market in the shares, and have drawn attention to the possibility of higher dividends under post-war conditions.

New Year Prospects

The Government policy of keeping down money rates and promoting cheap borrowing, is likely to be continued, so far as can be seen at present, well into the post-war period. If it should be, then to-day's prices of ordinary shares in front-rank companies may be regarded as not overvalued, even after the consistent upward movement of the last year or two. Another factor which contributes to maintenance of high prices is the closure of the New Issue market. When this ban is removed, and official permission becomes readily obtainable for new issues to be made, the effect upon the markets may be, of course, to re-adjust quotations. In the meantime, indications point to the strict Government control being maintained over financial matters, and to the probability that, twelve months hence, the capitalist, large or small, will have no reason to complain of the manner in which 1944 has treated the prices of most Stock Exchange securities.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given parentheses. Copies of any specification (1s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

BABCOCK & Wilcox, Ltd.—" Pulverised fuel burners." 8165/42. September 30th, 1941. (558059.)

J. L. Baird.—" Colour television apparatus." 9661. July 11th, 1942. (557992.)

H. E. Bayliss.—" Methods of manufacturing electric resistances." 3079. March 9th, 1942. (558052.) " Methods of manufacturing electrical resistances." 12201/43. March 9th, 1942. (Divided out of 558052.) (558070.)

British Power Boat Co., Ltd., and F. P. Parfitt.—" Wireless remote control systems." 3630. March 18th, 1942. (558003.) " Remote control apparatus." 3631. March 18th, 1942. (558004.)

British Rubber Producers' Research Association, and G. F. Bloomfield.—" Electrical resistances." 7986. June 11th, 1942. (558080.)

British Thomson-Houston Co., Ltd.—" Electric protective systems responsive to out-of-step conditions." 7558/42. June 3rd, 1941. (557974.)

British Thomson-Houston Co., Ltd., and E. R. Edinborough.—" Holders for double-ended electric lamps." 8312. June 17th, 1942. (558017.)

E. G. Budd Manufacturing Co.—" Welding apparatus." 3237/42. April 30th, 1941. (558072.) " Welding apparatus." 9847/43. April 30th, 1941. (Divided out of 558072.) (558089.)

J. H. Condy and London Passenger Transport Board.—" Heating of switches and operating mechanism of railway point layouts." 11355. August 13th, 1942. (557993.)

J. A. Crabtree & Co., Ltd., B. G. Harrison, and J. F. Duffield.—" Terminal or clamping devices for electric conductors." 3306. March 13th, 1942. (558053.)

E. D. Dennis.—" Electric vehicular head and other lamps for emitting diffused light." Cognate applications 8399/42 and 9318/42. June 19th, 1942. (558062.)

English Electric Co., Ltd., H. Dolan, T. R. Houston and W. E. Senhenn. — " Liquid servo-motors." 11642. August 19th, 1942. (557994.)

Ferranti, Ltd., and S. W. Holmes.—" Self-starting synchronous motors of the hysteresis type." 10018. July 18th, 1942. (558021.) " Self-starting synchronous motors of the hysteresis type." 10019. July 18th, 1942. (558022.)

General Electric Co., Ltd., and E. Friedlander.—" Electro-magnetic pumps." 7966. June 10th, 1942. (557986.)

A. Mandl and Metropolitan-Vickers Electrical Co., Ltd.—" Dynamo-electric machines." 224. January 6th, 1942. (557968.)

Marconi's Wireless Telegraph Co., Ltd., and F. R. Page.—" Demountable framework for radio transmitters and like apparatus." 7957. June 10th, 1942. (557984.)

Messier Aircraft Equipment, Ltd., and A. Arnot.—" Control gear for electric motor driven mechanisms." 6373. May 11th, 1942. (558075.)

Philips Lamps, Ltd. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken).—"Circuit arrangements for providing a compensated direct current supply to electrical apparatus." 375. January 9th, 1942. (558031.)

Pirelli-General Cable Works, Ltd., and R. Bean.—" Electric cable insulation." 2934. March 6th, 1942. (558033.)

Rediffusion, Ltd. (C. E. Gossling).—" Speed responsive devices." 8622. June 23rd, 1942. (557990.)

J. A. Sargrove.—" Operation of electronic vacuum tubes or valves." 4136. March 28th, 1942. (558036.)

A. H. Stevens (Electronic Laboratories, Inc.). —" Lamps." 8498. June 20th, 1942. (557989.)

Telephone Manufacturing Co., Ltd., and B. Drake.—" Electric frequency dividing systems." 12103. August 27th,1942. (558027.)

F. Watson (Aktiebolaget Elektrolux). — " Electric generators." 6903. May 21st, 1942. (558077.)

G. Wikkenhauser.—" Electrical power supply systems." 4787. May 11th, 1942. (558008.)

TRADE MARK APPLICATIONS

RECENT applications for British trade marks include the following, objections against which may be made within a month of December 29th, 1943:—

METVIC. No. 625,535, Class 7. Machines, machine tools, machine couplings, and motors (not for land vehicles). No. 625,537, Class 9. Scientific instruments and apparatus, electrical instruments and apparatus not included in other classes; and parts (not included in other classes) of all these goods.—Metropolitan-Vickers Electrical Co., Ltd., 1, Kingsway, London, W.C.2. Both to be associated with No. 396,424 (2184) vi and others.

MIP (in design). No. 624,063, Class 9. Scientific instruments, electrical instruments and apparatus not included in other classes, photo-electric cells, pyrometers, altimeters, revolution counters, liquid and gas flow meters, liquid level indicators or gauges, and turn and bank indicators for aircraft.—Measuring Instruments (Pullin), Ltd., Electrin Works, Winchester Street, Acton, London, W.3.

MULTEMP. No. 625,615, Class 11. Refrigerators and refrigerating apparatus.—Edwin M. L. Powell, 24, Raleigh Drive, Tolworth, Surbiton, Surrey.

TEMCO. No. 624,856, Class 14. Electric clocks.—Telephone Manufacturing Co., Ltd., Hollingsworth Works, Martell Road, West Dulwich, London, S.E.21.

UNIFLEX. No. 624,486, Class 17. Electrical insulating material, in sheet or tape form, composed principally of mica.—The Sterling Varnish Co., Hayesville, near Pittsburgh, U.S.A., and Fraser Road, Trafford Park, Manchester, 17. To be associated with No. 502,065 (2675) 1.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia. — QUEENSLAND. — February 11th. Brisbane City Council. Two (or alternatively three) 600-V mercury-arc rectifiers, each of 1,000-kW rating, together with transformers, high-voltage switchgear, supervisory control gear and accessories. Spec. £2 2s. General manager, Department of Transport. (*Tenders.*)

NEW SOUTH WALES.—January 20th. Sydney County Council. 11-kV metalclad switching equipment for Camperdown and Mascot substations. Spec. 643 (£1).

January 26th. State Railways. Two 1,500-kW automatically controlled rectifier units. Spec. 1105.

COMMONWEALTH.—P.M.G.'s Department. January 27th. Switchboard parts, Sch. C. 4290. Telephone parts and accessories, Sch. C.4286. February 8th. Long line equipment maintenance parts, Sch. C.4292.

New Zealand.—January 31st. Auckland City Council. Electrically driven pumping plant, capacity 8,000,000 gallons per day, for Lower Nihotupu dam.

Orders Placed

Australia.—COMMONWEALTH.—Department of Supply of Shipping. Reg. 3275, electric lamps (£3,728).—British General Electric Co.

Radcliffe.—Electricity Committee. Accepted. E.h.v. cables for supply of electricity to works.—Callender's Cable & Construction Co., Ltd.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ashton - under - Lyne.—Central kitchen for school meals; A. T. Kemp, borough surveyor, Municipal Buildings.

Beoley.—Workshop; N. A. Simcox, Lilley Green Lane, Beoley, near Birmingham.

Bridgnorth.—Farm workers' houses.—Bradley Farm, Kinlet, for R.D.C.; J. Brian Cooper, architect, Coleridge Chambers, 177, Corporation Street, Birmingham, 4.

Brighouse.—Works additions and boiler house; R. Kershaw, Halifax Road, Slead Syke.

Bury.—School canteen, Bury High School, Parliament Street; J. Chadwick, borough engineer, Municipal Offices, 28, Bank Street.

Darlington. — Workshop additions, Harris Street, for C. N. Hadley, motor engineer; Bussey & Armstrong, builders, Brinkburn Road.

Derbyshire.—Grammar School, Chesterfield; J. Harrison, county architect, county buildings, St. Mary's Gate, Derby.

Durham.—School meals cooking centres at Bishop Auckland and Cockton Hill; F. Willey, 34, Old Elvet, Durham City.

Glasgow.—Additions for Edward McBean & Co., Ltd.; manager.

Guildford.—Workshop; Warner Engineering Co.

Hebburn-on-Tyne.—Rebuilding of nursery school destroyed by fire; Page, Son & Bradbury, architects, 75, King Street, South Shields.

Ilford.—Offices, store and garage, 48-52, Ley Street; A. J. Worthing & Co.

Kilmarnock.—Adaptation of buildings (£2,500) for Western S.M.T. Co., Ltd., Portland Street; manager.

Lancashire.—School kitchen, Cansfield Grove Central Council School, Ashton-in-Makerfield; two classrooms, Lander Road, Litherland; and school kitchen, Grammar School, Chadderton; L. Evans, county architect, County Buildings, Fishergate Hill, Preston.

Lowton.—Youth Institute, Lancashire Service of Youth Committee; G. Moss & Sons, Ltd., builders, Back St. Helens Road, Leigh.

Manchester.—Extensions, wire works; J. Gerrard & Sons, Ltd., building contractors, Pendlebury Road, Swinton.

Newcastle-on-Tyne.—Extensions, clothing factory, for M. Russell & Co.; Marshall Tweedy & Bourne, Grainger House.

North Riding.—Canteen at Reeth School; J. Bagshaw, builder, Reeth.

Adaptations for provision of meals at Lythe C.E. School; county architect, County Hall, Northallerton.

Oldham.—Conversion of Friends' Meeting House into Junior Technical School; J. Heptonstall & Sons, Park Road, Oldham.

Richmond (Yorks).—Repairs and improvements (including new lighting, at Richmond Old Theatre; borough surveyor, Corporation Offices.

Rochdale.—School kitchen on housing estate; S. H. Morgan, borough surveyor, Town Hall.

Works canteen; Besco, Ltd., Hill Street.

Rubery.—Houses, Gunner Lane; H. Porritt, Ltd., builders, Ashwood Drive, Ten Ashes, Rednal, near Birmingham.

Sunderland.—Works extensions; H. E. Pitt, Ltd., building contractors, Leopold Street, Millfields.

Wakefield.—Kitchen, Sandal Council School; S. G. Wardley, city engineer and architect, Town Hall.

Walsall.—Workshop, Fieldgate; H. Frost & Co., Ltd., stirrup makers, 85, Fieldgate.

Warrington.—Pumping station for Waterworks Department; J. Gray, borough water engineer, Waterworks Offices.

West Hartlepool.—Fibre factory; J. J. Dobson, architect, West Hartlepool.

Wigan.—Bakery extension; J. Sellars, 47, Billinge Road.